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DISCUSSION PAPER

Performance comparison of patient pathways in Nordic capital areas

A pilot study

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Foreword

This report describes part of the work that has been done for Work Package 11 (WP11) of the BRIDGE Health project (BRidging Information and Data Generation for Evidence-based Health policy and research, http://www.bridge-health.eu/). By making use of available routinely collected data, the WP11 updates and further develops the EuroHOPE research infrastructure (http://www.eurohope.info/), aiming to evaluate the performance of health-care systems in terms of outcomes, quality, use of resources and cost. This includes maintaining and updating the protocols for select conditions (acute myocardial infarction, acute coronary syndrome, stroke and hip fracture). The protocols include, e.g. inclusion and exclusion criteria, defining the cycle of care (when it starts, handling of transfers, follow-up, etc.), comorbidities (used in risk-adjustment) and specifying the process, utilisation, cost and outcome measures. National, regional and hospital-level indicators covering the years 2006/2009–2014 were calculated for Finland, Denmark, Hungary, Italy, Norway and Sweden. In 2016, the updated protocols and indicators were made available on the EuroHOPE web pages. National and regional indicators were published for Denmark, Finland, Hungary, Italy, Norway and Sweden. These have been discussed in a press release of the main results, released May 2017 (available at: https://thl.fi/en/web/thlfi-en/-/persistent-differences-in-health-outcomes-for-major-medical-conditions-across-europe).

In this report, the episode-based approach was extended to also include primary health care and social services in a pilot study using data from four metropolitan areas: Copenhagen, Helsinki, Oslo and Stockholm. Thus, the methodological innovation of this pilot study was the linking of hospital, cause-of-death registers and data on prescribed medicines with the registers for primary and long-term care via the use of personal identification numbers, which makes it feasible to analyse the patients' care pathways at different levels of care and for a period that covers one year before and one year after the onset of a disease.

Abstract

Unto Häkkinen, Christopher Engel-Andreasen, Fanny Goude, Terje P. Hagen, Marie Kruse, Tron Moger, Mikko Peltola, Clas Rehnberg. Performance comparison of patient pathways in Nordic capital areas.
A pilot study. National Institute for Health and Welfare (THL). Discussion paper 22/2018. 55 pages. Helsinki, Finland 2018.
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This report describes and discusses the work which extends the episode-based approach to include primary care and social services. The methodological innovation of this pilot study was the linking of national registers on hospital discharges, use of prescribed medication and causes-of-death with the registers for primary and long-term care via the use of personal identification numbers, which makes it feasible to analyse the patients' care pathways at different levels of care and for a period that covers one year before and one year after the onset of a disease.

By using linkable, patient-level data on new acute myocardial infarction, acute coronary syndrome, stroke and hip fracture patients from Copenhagen, the Helsinki area, Oslo and Stockholm, this pilot study i) extended the disease-based performance analysis to include new indicators that better describe patient care pathways at different levels of care; ii) described and compared the performance of care given in the four metropolitan areas; iii) evaluated how additional data (primary and social services, better risk-adjustment and new outcome measures) change the rankings of performance between the areas and discussed their usefulness at better understanding the reasons behind performance difference; and iv) described the trends in performance in the metropolitan areas.

According to our results, differences exist in various performance indicators between the four metropolitan areas, but the ranking was sensitive to the risk-adjustment method. The study showed that for patients with mixed-care pathways across primary, secondary, tertiary and social services, a performance comparison with data only from the secondary and tertiary care is not always reliable for international comparisons. The approach studied and presented here represents an important extension in the field of health system performance analysis. With individual-level, routinely collected data, it is possible to considerably deepen the analysis and enrich the set of outcome and process indicators used for system performance comparison.

Keywords: Performance comparison, patient pathways, risk-adjustment, acute myocardial infarction, acute coronary syndrome, stroke, hip fracture

Tiivistelmä

Unto Häkkinen, Christopher Engel-Andreasen, Fanny Goude, Terje P. Hagen, Marie Kruse, Tron Moger, Mikko Peltola, Clas Rehnberg. Hoitopolkujen toimivuus Pohjoismaiden pääkaupunkiseuduilla - pilottitutkimus. Terveyden ja hyvinvoinnin laitos (THL). Työpaperi 22/2018. 55 sivua. Helsinki 2018.
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Raportissa laajennetaan aikaisempaa sairaalahoitoon perustuvaa hoitoketjujen tarkastelua perusterveydenhuoltoon ja vanhustenhuoltoon. Pilottitutkimuksessa on yhdistetty potilastasolla kansallisten sairaaloiden hoitoilmoitus-, kuolinsyy- ja lääkerekisterien tietoja perusterveyden- ja vanhustenhuollon rekistereitä koskeviin tietoihin. Tämä on mahdollistanut potilaiden hoitopolkujen tarkastelun hoidon eri tasoilla ja sektoreilla ajanjaksona, joka kattaa vuoden ennen sairauden toteamista sekä vuoden toteamisen jälkeen. Tutkimuksessa tarkastellaan sydäninfarkti/sepelvaltimotautikohtaus-, aivoinfarkti- sekä lonkkamurtumapotilaiden hoitopolkuja Helsingin alueella (Helsinki ja Espoo), Kööpenhaminassa, Oslossa ja Tukholmassa. Tavoitteena on i) laajentaa hoitoketjujen arviointia sisältämään uusia indikaattoreita, jotka aikaisempaa paremmin kuvaavat potilaiden hoitopolkuja hoidon eri tasoilla; ii) kuvata ja vertailla hoitoketjujen toimivuutta pääkaupunkiseuduilla; iii) arvioida kuinka perusterveyden- ja vanhustenhuollon sisällyttäminen tarkasteluun vaikuttaa alueiden väliseen vertailuun ja tarkastella tämän uuden informaation hyödyllisyyttä suoriutumiskyvyn erojen ymmärtämisessä sekä; iv) kuvata suoriutumiskyvyn ajallista kehitystä pääkaupunkiseuduilla.

Tutkimuksessa havaittiin selviä eroja suoriutumiskyvyssä alueiden välillä tarkastelluissa potilasryhmissä mutta erot olivat herkkiä sille, miten riskivakiointi suoritettiin. Tutkimus osoitti, ettei pelkästään sairaalahoitoon perustuva suoriutumiskyvyn kansainvälinen vertailu ole luotettavaa. Hankkeessa kehitetty lähestymistapa tarjoaa tärkeän täydennyksen suoriutumiskyvyn arviointiin sekä antaa esimerkkejä mahdollisten uusien ja kattavampien prosessi- ja vaikuttavuusmittareiden käytön hoitoketjujen sekä kansallisessa että kansainvälisessä vertailussa.

Avainsanat: Suoriutumiskyvyn arviointi, hoitoketjut, riskivakiointi, sydäninfarkti, sepelvaltimotauti-kohtaus, aivoinfarkti, lonkkamurtuma

Sammandrag

Unto Häkkinen, Christopher Engel-Andreasen, Fanny Goude, Terje P. Hagen, Marie Kruse, Tron Moger, Mikko Peltola, Clas Rehnberg. Jämförelse av prestationer, utfall och patientflöden i Nordiska storstadsområden. En pilotstudie. Institutet för hälsa och välfärd (THL). Diskussionsunderlag 22/2018. 55 sidor. Helsingfors, Finland 2018.
ISBN 978-952-343-134-8 (nätpublikation)

Denna rapport beskriver och diskuterar arbetet som utökar den episodbaserade ansatsen till att inkludera primärvård och socialtjänst. Den metodologiska innovationen av denna pilotstudie var sammanlänkningen av det nationella patientregistret, dödsorsaksregistret och läkemedelsregistret med register över primärvård och långtidsvård genom att använda individuella identifieringsnummer, vilket gör det möjligt att analysera patienternas flöden mellan olika vårdformer och under en period ett år före och ett år efter insjuknande av en sjukdom. Genom användning av sammanlänkad patientdata för nya patienter med akut hjärtinfarkt, akut koronarsyndrom, stroke och höftfraktur från Köpenhamn, Helsingfors, Oslo och Stockholm har denna pilotstudie i) utökat analysen av sjukdomsbaserade utfall till att inkludera nya indikatorer som bättre beskriver patientflödet mellan vårdformer; ii) beskrivit och jämfört prestationer och utfall av vård som givits i de fyra storstadsområdena; iii) utvärderat hur ytterligare data (primärvård och socialtjänst, bättre riskjustering och nya utfallsmått) förändrar rangordningen mellan områdena samt diskuterat användbarheten för en bättre förståelse av orsakerna till skillnader i prestationer och utfall och; iv) beskrivit trenderna i prestationer och utfall mellan storstadsområdena.

Enligt våra resultat finns det skillnader i de olika indikatorerna över prestationer och utfall mellan de fyra storstadsområdena, men rankningen var känslig för val av metod för riskjustering. Studien visade att för patienter med ett mixat flöde mellan vårdformer som primär-, sekundär- och tertiärvård samt socialtjänster, är jämförelser av prestationer och utfall med data från endast sekundär- och tertiärvård inte alltid pålitlig för internationella jämförelser. Den ansats som använts i studien och presenteras i rapporten är en viktig utveckling av ämnesområdet rörande analyser av prestationer och utfall mellan hälso- och sjukvårdssystem. Genom att samla in och sammanställa data på individuell nivå är det möjligt att avsevärt fördjupa analysen och utöka indikatorer för såväl utfall som processer för att jämföra prestationer mellan sjukvårdssystem.

Nyckelord: Jämförelse av prestationer och utfall, patientflöden, riskjustering, akut hjärtinfarkt, akut koronarsyndrom, stroke, höftfraktur

Contents

1 Introduction

Performance-based governance requires timely and accurate patient data that span the whole care pathway, including health outcomes and costs. Such data are also used to support the redesign and evaluation of new models of health-care service delivery and contribute to the discovery and evaluation of new treatments. Health-care data collected by national registries and other administrative databases, which can be linked with each other at the individual level, are a valuable resource that can be safely used to improve patients' health outcomes and the quality and performance of health-care systems. Although there is immense potential in these data, they are not routinely used to serve the aims of increasing service system performance. Thus, there is room for promoting their use to support efficiency objectives.

Essential to health-care quality and performance assessment is the ability to follow patients as they progress through the health and social care system: from primary health care to specialty visits to hospitalisations, long-term care, home care, hospice care and death. This type of follow-up allows for a comprehensive view of the health-care services provided and the health outcomes generated by those services; it also makes it possible to uncover and assess inappropriate or avoidable service use, adherence to clinical guidelines, effective treatments, optimal care paths, use of resources and cost of services.

The data included in national health information systems vary between countries in terms of coverage, coding and terminology, quality of data, data sharing and linkage possibilities (OECD 2015). This is the main challenge of every iternational performance comparison.

A disease-based approach was adopted for evaluating the performance of European health-care systems (including Finland, Hungary, Italy, the Netherlands, Norway, Scotland and Sweden) as part of the EuroHOPE project, using the experiences of the PERFECT project. The project developed methods (Häkkinen et al. 2013; Moger and Peltola 2014; Iversen et al. 2015) and indicators (Malmivaara et al. 2015) for an international register-based health-care performance measurement and comparison, giving proposals concerning the data content of national registers in order to improve national- and international-level continuous monitoring and implement European-wide health-care benchmarking.

The study is part of an effort to update and further develop the EuroHOPE research infrastructure, with the aim of evaluating the performance of health-care systems in terms of outcomes, quality, use of resources and costs. These include maintaining and updating the EuroHOPE protocols for selected diseases/conditions (acute myocardial infarction, stroke, hip fracture). The protocols include, e.g. inclusion/exclusion criteria, defining the cycle of care (when it starts, follow-up, etc.), comorbidities (used in risk-adjustment) and specifying the process, utilisation and cost and outcome measures. National, regional and hospital-level indicators have been calculated for Finland, Denmark, Hungary, Italy, Norway and Sweden (http://www.eurohope.info). In this pilot study, the databases have been extended to include primary health care and social services using data from the capital area of Finland (Helsinki and Espoo), Copenhagen, Oslo and Stockholm.

2 Aims

Using linkable patient-level data on incident acute myocardial infarction (AMI), acute coronary syndrome (ACS), stroke and hip fracture patients, the present pilot study will:

• Extend disease-based performance analysis to include new indicators that better describe patient care pathways at different levels of care;

• Describe and compare the performance of care given in the four metropolitan areas;

• Evaluate how additional data (primary and social services, better risk-adjustment and new outcome measures) change the rankings of performance between the areas and discuss their usefulness for better understanding the reasons behind performance differences;

• Describe the trends in performance between the metropolitan areas.

3 Institutional settings

The health care systems in the Nordic countries are generally regarded as being similar, but significant differences exist in the organisation of health care as well as in practical health policies between the Nordic countries (Lykens et al. 2016; Magnussen et al. 2009). The Nordic countries are subject to various levels of decentralisation. In Denmark, the health-care system is embedded in a decentralised administrative structure consisting of five regions and 98 municipalities. In Finland, the system is the most decentralised because 315 municipalities are responsible for arranging and taking financial responsibility for an entire range of health services, which also includes health centres that provide primary health-care services. In Sweden, the county councils are responsible for hospital and primary care, and there are relatively large variations in the organisation and remuneration schemes among them. The Norwegian model is the most centralised: primary care and long-term care services are organised and financed at the municipal level, while hospital services are organised and financed by health enterprises that are part of larger state-owned units called Regional Health Authorities.

Regarding the patient pathways of the three disease groups considered in this study, important differences between the countries can be expected to be related to at least two issues: vertical integration of providing and financing health and social services and the arrangement of general practitioner (GP) services (Häkkinen and Johnsson 2009; Iversen et al. 2016; Olsen et al. 2016). The vertical integration of provider responsibilities is rather high in Finland, as the various municipalities are financially responsible for all health and social care. In Denmark, Sweden and Norway, vertical integration is lower, as the responsibility is divided between two tiers (regional authorities and municipalities). Denmark and Sweden have, however, had payment systems that may integrate the two tiers. Vertical integration has been lower in Norway. The Coordination Reform of 2012 may have changed this situation, though, as new payment systems between municipalities and hospitals have now been implemented.

In Denmark and Norway, GPs are self-employed and operate on contract with the different regions (Denmark) or municipalities (Norway) as private practitioners (five per cent of Norway's salaried GPs are primarily located in remote areas). In Sweden, the organisational schemes vary between public and private GPs. Most physicians working at public health centres are salaried employees, whereas most private GPs are self-employed in solo or group practices. Sweden is the only Nordic country to allow corporate ownership, which is a smaller share of the private GP sector. Most doctors are still employed by public providers; however, there is a trend towards more private practices, particularly in certain regions where about 50% of provision is private. This trend has been supported by national regulations since 2010 that encourage freedom of establishment for private providers, competition between primary care providers on equal terms and enhanced patient choice. In Finland, GPs working at health centres are also mainly salaried doctors, although they can either supplement their salary with a fee per consultation according to agreements made at the local level.[1]

Next, we describe in more detail how health and social care have been organised in the four metropolitan areas that are the focus of the study.

[1] In Finland, the GP services are also provided by private doctors and occupational health care is partly reimbursed by the Social Insurance Institution. However, these providers mainly offer services to children and the working-age population. Thus, the municipal health centers are the main providers of GP services for the patients considered in this study.

3.1 Denmark/Copenhagen

In Denmark, all public hospitals are owned and run by five regions. Primary health care (GPs and practising specialists) is financed by the regions as well. Home-based care, nursing home care and rehabilitation after discharge from a hospital are municipal responsibilities. Each of the regions and their municipalities coordinate the treatment of their patients. Patients diagnosed with specific chronic illnesses and patients discharged with an identified need for rehabilitation have a right to rehabilitation and health-promotion services from the municipality. In addition, the municipality can initiate rehabilitation if it considers such rehabilitation appropriate. The allocation of home nursing and home help is based on an assessment of need, either by the municipality itself or by the hospital. Copenhagen is the largest municipality in Denmark, with almost 600,000 inhabitants. The municipality covers most of the capital, and hence, a very diverse population in terms of demographics and socio-economic status.

Citizens of Copenhagen are also citizens of the capital region (total population 1.4 million), which is responsible for the financing of hospitals and primary health care. Like the rest of the country, hospital care is provided by regionally-owned hospitals, while primary health care is provided by private practices that negotiate their tariffs with the regions. There are no co-payments in either hospitals or primary health care. The municipal services are divided into health and social care. Municipal health services cover home nursing and rehabilitation/health promotion for all age groups and home help and nursing homes for people over 64. These services for younger citizens are considered social services. Generally, people younger than 65 would only require such services if they are disabled. Home nursing is care provided by trained nurses or nurse assistants in the home of the patient. Home nursing is prescribed by the general practitioner or hospital, and the nursing and all equipment, etc., is financed by the municipality with no co-payments. Rehabilitation and health promotion usually take place in the health centres. The intensity and organisation of the rehabilitation varies. Citizens with a need for rehabilitation are offered either individual sessions or class training, depending on their needs and their circumstances. Home help is divided into personal care (e.g. bathing) and practical assistance. The municipality assesses the need of the citizens and then offers, e.g. 20 minutes per day or 1 hour per week of assistance. Citizens (or their relatives) can apply for a nursing home residence. This application is then assessed by the municipality. There is a waiting list for nursing homes, and a nursing home residence can be provided up to several months after completing an application (Ministry of Health 2017).

3.2 Finland/Helsinki area

In Finland, municipalities are responsible for arranging and financing health and social services. Many municipalities have merged their health and long-term service administration, including the budgeting of these services, in order to improve the coordination and integration of services. In Finland, most of the hospitals are owned by a federation of municipalities and are thus financed by the municipalities via reimbursement methods decided at the local level (Vuorenkoski et al. 2008). Although a Diagnoses Related Group (DRG) is used in most of the hospital districts, it is not centrally decided beforehand, and its main aim is not to motivate an increase in activity and efficient production of hospital services, but to equalise the municipal financing so that it is based on the accurate use of services.

Since municipalities in Finland are responsible for financing all public health and long-term services, and even other services (basic education, social services, day care, etc.), they have motives for developing local-level actions to contain costs. The local interventions have usually been made at the municipal level, sometimes creating considerable differences in care pathways even between neighbour municipalities. For example, within the capital area of Helsinki, there was great variation between the municipalities in how rehabilitation and other activities following hospitalisation were organised (Mäkelä et al. 2007). In Finland it is widely accepted that the primary care provided for inactive people is underfunded (Vuorenkoski et al. 2008), and many initiatives aiming to improve the quality and volume of primary health care have not succeeded thus far (Olsen et al. 2016). Improving the role of primary care is also the starting point for the current health and social care reform, which is under preparation in 2018.

This study includes two cities in the Helsinki area: Helsinki (pop 620,715 in 2014) and Espoo (pop 265,543). The two cities provide primary health-care services and social-care services separately to their populations. In Finland, the municipalities can decide the co-payments up to a maximum decided by the government. In hospital care, there are co-payments for adults throughout the whole country, but some municipalities offer GP services provided by municipal health centres free of charge. Helsinki abolished the charges for GP services at the beginning of 2013, whereas in Espoo co-payments have been in use continuously.

In the Helsinki area, specialised care is provided by the Helsinki and Uusimaa hospital district. Most acute specialist care is produced by the Helsinki University Hospital, which used DRGs as the main reimbursement method. The hospital district of Helsinki and Uusimaa introduced a fine to reduce bed-blocking in 2007 in order to increase the efficiency of the hospital. This practice was abolished in September 2009, but reintroduced in July 2011. The fee was €365 per day in 2011, €465 per day in 2012, and €600 per day in 2013 and 2014, i.e. much higher than the average cost per day in health centres, rehabilitation institutes and nursing.

3.3 Norway/Oslo

In Norway, all public hospitals are owned and operated by the four state-owned regional health authorities (RHAs). The RHAs also contract with non-profit and for-profit hospitals. Somatic care is financed by the central government using fixed DRG prices (50%) and risk-adjusted capitation (50%). Psychiatric care and care for addicts is financed by risk-adjusted capitation. Primary health care, social care and long-term care are financed by the municipalities. A specific fee-for-service from the central state covers parts of the GP's revenues. The municipalities are financed by local taxes and grants from the central state. There are co-payments both in primary health care and hospital outpatient consultations, but not for inpatient stays.

The capital of Norway, Oslo, has a population of approximately 675,000 inhabitants (2018) and is divided into 15 boroughs, which are delegated the responsibility for primary, social and long-term care. Four hospitals (Oslo University Hospital, Akershus University Hospital and the two non-profit hospitals Diakonhjemmet and Lovisenberg) are responsible for specialist care, each with a specific catchment area, but with close cooperation regarding tertiary care.

The Coordination Reform represents a comprehensive policy package involving several measures to better integrate the two levels of services (MoHC 2009). Two new laws were implemented: the Norwegian Public Health Act and the Act of Municipal Health and Care Services, both of which aim to reinforce the municipalities' responsibility for public health. The two most important financial measures of the Coordination Reform included (a) municipal co-financing of patients treated in the state-owned specialist health care services and (b) municipal financial responsibility for patients ready for discharge (Forskrift om medfinansiering av spesialisthelsetj. FOR-2011-06-29-695, 2012). Municipal financial responsibility for patients ready for discharge was enforced by the implementation of a fee to reduce patient overstays in hospitals, so-called bed-blocking (Gaughan et al. 2015). The fee was paid by the municipality to the hospitals for patients declared ready for discharge who were in need of services from the municipalities, but were unable to leave the hospital because of a lack of municipal services. The hospitals had to notify the municipalities in advance about patients who needed municipal services. The fee was set at approximately €535 per day (4,000 NOK) in 2012 and paid from day one after the patient was declared ready for discharge (1 €=7.47 NOK, which was the exchange rate in 2012). Also included in the reform package was an economic stimulus for the municipalities to build up services to tackle the increased care burden. Initial analyses indicate that the fee has reduced the length of stay in hospitals for the relevant patients (Melberg and Hagen 2016).

3.4 Sweden/Stockholm

In Sweden, the 21 county councils are responsible for financing and arranging health care, whereas the 290 municipalities are in charge of institutional and home care for the elderly. The county councils levy their own taxes for such care, which covers 70% of their costs while 20% is paid through central government grants. The capital of Sweden, Stockholm, is part of the greater Stockholm county council (total population 2.2 million in 2014).

Hospital service is mainly provided by county council-owned hospitals on three levels: university, central and county hospitals. Each county decides on the reimbursement system, and there has been a decline in the share of hospitals that are reimbursed with the DRG systems. In 2015, less than half of them were reimbursed via the DRG system, while the others were reimbursed by budgets or block grants. There are co-payments both in hospitals and primary health care

In Stockholm, there are seven acute hospitals, wherein the two university hospitals have been merged into a single organisation. There is one for-profit hospital and three hospitals under public corporate ownership by the county council in Stockholm. During the study period, the Stockholm county council applied a system where the variable part based on DRGs comprised approximately 75–80% of the total reimbursement and a fixed payment of approximately 10%. The remaining part was also variable, but based on quality indicators and a patient choice model for specific procedures.

There is a patient co-payment for outpatient consultations, and a small fee charged per day for inpatient stays. Both payments are combined with a maximum ceiling for patient fees and applies to all county councils.

The primary health-care sector has traditionally been under public provision based on catchment areas. However, since 2010 the new legislation has stipulated a choice of primary care provider for the population and freedom of establishment for providers accredited by the local county councils. Patients can register with any public or private providers, which are reimbursed by the county councils on equal terms. In Stockholm, the share of private GPs is approximately 60% of the market, and the reimbursements constituted a mix of capitation (40%) and payment per visit (60%) during the study period.

In Sweden, nursing homes and home care for older people and patients with chronic conditions are the responsibility of the 290 municipalities. However, the medical responsibility rests with the county councils. The so-called 1992 ÄDEL Reform shifted the responsibility for care for older people from the county councils to the municipalities. Collaboration with primary care services is needed, as municipalities are not allowed to employ physicians, only nurses and other personnel. For this purpose, nursing homes generally have agreements with health centres. In relation to hospital care, discharge planning for the elderly in collaboration with the municipality and primary care are mandatory. The municipality is required by law to organise an adequate capacity of nursing home services. In Stockholm, the system and collaboration between the county council and the 26 municipalities is somewhat different, as the county council is in charge of home visits concerning health services performed by nurses.

Problems of so-called bed-blockers have been discussed for decades, with municipalities having to pay a fine for patients declared ready to be discharged from a hospital since the ÄDEL Reform. Regulation has been strengthened several times since then, and studies suggest that the problem of so-called bed-blockers has been reduced due to these policies. However, after each change the significant problems related to bed-blockers have reached a new plateau and are still being debated with respect to the elderly and improving the efficiency of hospitals.

4 Data and Methods

4.1 Data

This study analysed annual cohorts of AMI, ACS, ischemic stroke and operated hip fracture patients from Copenhagen (CPH), the Helsinki metropolitan area (municipalities of Helsinki and Espoo, HEL), Stockholm (STO) county and Oslo (OSL). The total numbers of population (2014) were as follows:

- Copenhagen 569,557, of whom those over 69 years of age is 6.6 %
- Helsinki area 886,260, of whom those over 69 years of age is 9.9 %
- Oslo 641,550, of whom those over 69 years of age is 8.1 %
- Stockholm 2,198,044, of whom those over 70 years of age is 10.6 %.

The construction of data was based on a common protocol using routinely collected national registers and statistics on hospital discharges, use of prescribed medication and causes of death (Häkkinen et al. 2013; Moger and Peltola 2014). We defined episode of care as referring to the entire treatment pattern from the beginning (e.g. time of diagnosis) of the disease to the end of the treatment across organisational boundaries to face the health problem at hand within a specific time frame. Thus, the protocols for an episode include the definitions of start and finish dates (follow-up time) as well as inclusion and exclusion criteria, which are used when constructing a comparison data set for a specific disease group.

Episodes of AMI, ACS, stroke and hip fracture start with an acute phase in the hospital, usually occurring immediately after the event. For stroke, we included only cerebral infarction (ischemic stroke) patients, and for hip fracture only operated patients. The beginning of the episode (index day) was defined as the first hospital day of a hospital admission with a specific primary diagnosis (AMI ICD-10 codes I21–I22; ACS ICD-10 codes I20.0, I21–I22; ischemic stroke ICD-10 code I63; hip fracture ICD-10 codes S72.0–S72.2), using two exclusions. First, we excluded all patients who had a hospital admission related to the condition in question during the 365 days prior to the index day. Second, we excluded foreigners and patients with an incomplete personal identity number. In addition, for hip fracture we excluded patients younger than 50 years.

For this pilot study, we extended the approach to primary health and long-term care services by collecting data on these services from local municipal registers. We constructed a comparative database that allows for performance analysis, research and use of indicators at the local (capital area) level (Figure 1). Our approach requires patient-level data covering the whole population in the selected areas and the possibility to deterministically link individuals' records in the different national registers used.

The construction of patient cohorts is described in the protocols (EuroHOPE 2016a, 2016b, 2016c). Each partner was individually responsible for producing its own local EuroHOPE comparison data, with the principles stated in the disease-specific study protocols.

For this study, we created new variables that also cover the use of primary and social services. To track the patients' movements along the care pathway, we constructed a new four-digit state variable that describes the services the patient received for each day 365 days before and 365 days after the index day (Sund and Häkkinen 2016). The index day is also included in the state variable. The first digit specifies whether the patient was at home with no services, whether services were received and whether the patient was dead or alive. The second digit specifies a hierarchy of services, with the use of university hospitals at the top level and different types of hospital and long-term care services with home help at the lowest level. The third digit indicates whether or not the hospital stay had the specific condition (AMI/ACS, ischemic stroke or hip fracture) as the main diagnosis, and the fourth digit indicates a hierarchy of outpatient services with a hospital outpatient visit at the top and GP visits at the bottom.

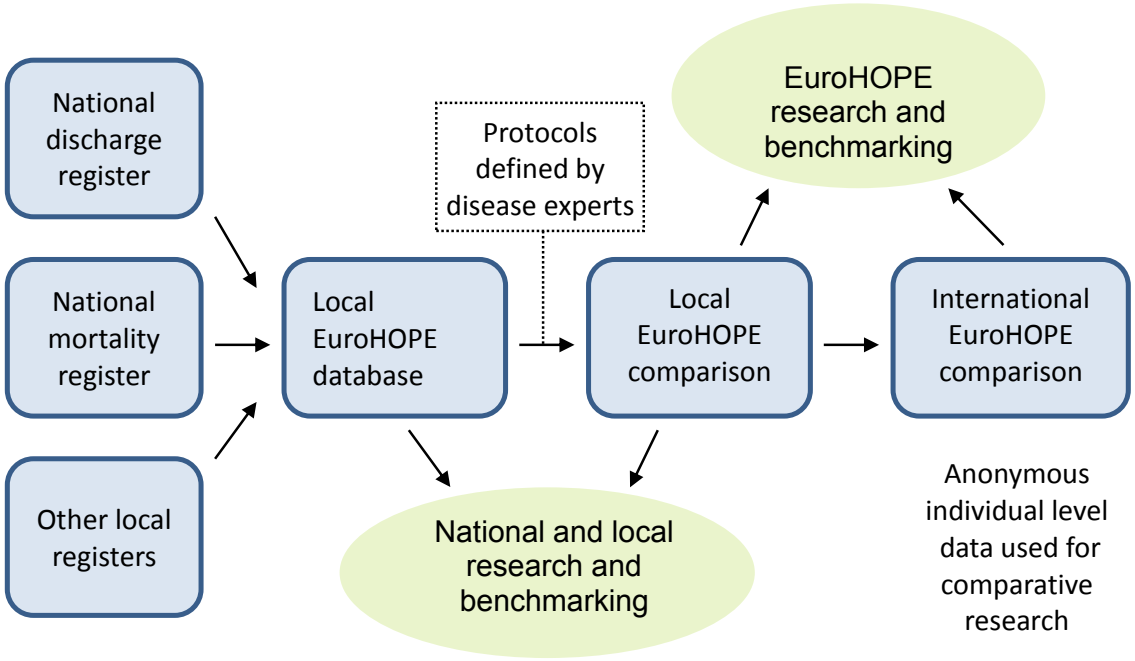

Figure 1. Description of the creation of the data.

In addition, we collected new variables describing the total number of various visits at 90 and 365 days before and after the index day. The visit categories were as follows:

(a) Day surgery
b) Outpatient visits to hospital
c) Outpatient physician consultation with private or public specialist outside hospital
d) GP visit
e) Consultations with local emergency centre patients
f) Home visits by doctor
g) Visits to a nurse in primary care
h) Home care (help) visits.

4.2 Performance measures

A simple descriptive analysis of outcomes can be made using this new state variable. It describes each 365 day period before and after the index day to which the exclusive service/setting groups/patients belong. From the new state variable, we calculated descriptive statistics on service use and outcomes, such as the share of patients permanently discharged to home within 90 days and still alive at the end of the period. Here, permanently means that a patient must be continuously at home for at least two weeks after discharge, i.e. without being transferred to any inpatient care facility within that period. We calculated the measures separately for overall discharges to home and for discharge to home without any home help services within the two-week period.

Outcomes were also measured by mortality (30-day, 90-day, and one-year) and by the share of patients institutionalised within 90 and 365 days. Institutionalisation was defined as the patient being in inpatient care (including, e.g. a nursing home) all days during the follow-up time.

Service utilisation was measured by number of visits (GP, other doctor visits[2] and home help services) and bed days within one year after the index day. Length of stay (LOS) was defined in three ways: for acute hospital episode (including transfers between acute hospitals), acute care and rehabilitation episode, and the first institutional episode that also includes, in addition to the acute hospital care and rehabilitation, long-term care institutions like nursing homes during the first 90 days after the index day if a patient is transferred to such institutions immediately after acute care and rehabilitation admissions.

In addition to using LOS as a measure of resource utilisation, costs were measured by using the Finnish standard cost of specific cost items (Kapiainen et al. 2014), which were deflated to 2014 price levels. In acute hospital care, costing was done by regressing the cost at the individual level using data from patients treated at Helsinki University Hospital against resource items (e.g. hospital days, use of a specific procedure, type of fracture). Patient-level costs were then derived using the coefficients of the regression models. The descriptions of the costing methods are described in Appendix 1. Data on some cost items (e.g. prescribed drugs, visits to a nurse in primary care and private health care services) was only available from the Helsinki area. Their share of the total cost was estimated to be from 2 to 5%.

4.3 Missing data

We had full data covering the cohorts from the years 2009–2014 only from the Helsinki area. For Copenhagen, we had full data only for the 2014 cohort. For Stockholm, the data covered the cohorts for 2009–2014, but did not include information on institutional long-term care or home help services (except home visits by nurses and doctors). Data on prescribed medicines from Stockholm was only available since July 2010.

For Oslo, it was not possible to obtain data on the prescribed medicines. Furthermore, we could only follow patients to the end of the year 2014. Thus, we could not calculate the indicators requiring a 365-day follow-up for patients treated in 2014. For the variables based on a shorter follow-up, we excluded patients with an index day after mid-September of 2014.

Table 1 describes the main performance indicators and their availability by the metropolitan area.

4.4 Risk-adjustment

Patient-associated factors must be accounted for when comparing the areas. We have endeavoured to ensure meaningful comparisons using three steps. First, we defined the disease groups so that they are as comparable and homogeneous as possible. Second, we gathered information on risk factors from the patients' medical history and patient use of services before the onset of the disease (based on the state variable). Third, we applied statistical models to adjust the indicators and calculated their 95% confidence intervals.

Age, sex and type of disease are the most commonly used variables in risk-adjustment. Here, we used two additional sets of variables: the number of days a patient had been in different service settings before the index day and comorbidities. Using the state variable, we calculated the number of days the patient had been in acute hospital care, other institutional care and home help during the 90 days before the index day.

Comorbidities were assessed using patients' medical records of the previous year from two data sources: i) based on the primary or secondary diagnoses recorded during hospital admissions within 365 days prior to the index admission, and ii) based on purchase of medications that can be linked to particular diagnoses (Moger and Peltola 2014). We calculated the comorbidity for 12–13 diseases (Table 2).

[2] Include visits to specialist, emergency and outpatient departments of hospitals

Table 1. Performance indicators and their availability in the capital areas

Performance indicator	Data available
30-day mortality	CPH 2014, HEL 2009-2014, OSL 2009-2014, STO 2009-2014
90-day mortality	CPH 2014, HEL 2009-2014, OSL 2009-2014, STO 2009-2014
One-year mortality	CPH 2014, HEL 2009-2014, OSL 2009-2013, STO 2009-2014
Share of patients discharged home (total) within 90 days	CPH 2014, HEL 2009-2014, OSL 2009-2014
Share of patients discharged home (without help) within 90 days	CPH 2014, HEL 2009-2014, OSL 2009-2014,
Share of patients institutionalised (90 days)	CPH 2014, HEL 2009-2014, OSL 2009-2014
Share of patients institutionalised (one year)	CPH 2014, HEL 2009-2014, OSL 2009-2014
Length of first acute hospital admission	CPH 2014, HEL 2009-2014, OSL 2009-2014, STO 2009-2014
Length of first acute hospital and inpatient rehabilitation admissions	CPH 2014, HEL 2009-2014, OSL 2009-2014, STO 2009-2014
Length of first institutional episode	CPH 2014, HEL 2009-2014, OSL 2009-2014
Number of all inpatient days (including long-term care), one year	CPH 2014, HEL 2009-2014, OSL 2009-2013
Number of GP doctor visits (one year)	CPH 2014, HEL 2009-2014, OSL 2009-2013, STO 2009-2014
Number of other doctor visits (one year)	CPH 2014, HEL 2009-2014, OSL 2009-2013. STO 2009-2014
All home help visits (one year)	CPH 2014, HEL 2009-2014, OSL 2009-2013
Cost of first acute hospital episode	CPH 2014, HEL 2009-2014, OSL 2009-2014, STO 2009-2014
Cost of first acute hospital and inpatient rehabilitation episode	CPH 2014, HEL 2009-2014, OSL 2009-2014, STO 2009-2014
Cost of first institutional episode	CPH 2014, HEL 2009-2014, OSL 2009-2014
One-year cost	CPH 2014, HEL 2009-2014, OSL 2009-2013

Likewise, the availability of data for various performance measures and risk-adjustment variables varied between the capital areas. Thus, for each performance indicator we performed risk-adjustment with four different sets of confounders, as indicated in Table 3.

For all performance indicators, a modelling strategy for risk-adjustment was adopted: logistic regression for dichotomous responses (e.g. mortality), generalised linear modelling for continuous variables (e.g. costs gamma distribution with logit-link) and negative binomial modelling for discrete variables (e.g. length of stay). Ideally, the individual-level data from all participating areas would be pooled before estimating the risk-adjustment models. However, at this stage we did not have permission from all the partners to pool the individual-level data. Thus, we applied a standard approach for indirect standardisation in which the parameter estimates for the confounding factors were first estimated for each performance indicator using the data from the Helsinki area from the years 2009–2014. Then, the coefficients of each model were made available to all partners, who then calculated individual-level predicted values for the indicators. The predicted values were then summed up for an area by year. The ratio of the observed value and the expected value of the dependent variable in the comparable unit was multiplied by the average value of the indicator in the Helsinki area data to constitute the risk-adjusted indicator. Thus the adjusted estimates correspond to assuming effects of all risk adjusters are the same as in the Helsinki area. The calculation of the risk-adjusted indicators using data for all years (Tables 4-8) was based on models that also included

year dummies. It should be noted that confidence intervals reflect the numbers of patients included in the sample. Thus they are very wide for Copenhagen and narrow for Stockholm. The mean values of the variables included in risk-adjustment for the capital areas and performance indicators are reported in Appendix Tables 1–5.

The age- and sex-standardised incidence figures for the diseases were carried out via indirect standardisation using the age and sex reference values for the Helsinki area from the years 2009–2014 as the basic population.

Table 2. Comorbid diseases and their operationalisation from the study data

Comorbidity	ICD-10	ATC-code
Hypertension	I10*-I15*	C03*, C07* (with neither coronary artery disease nor atrial fibrillation indicates hypertension), C08*, C09*
Coronary artery disease	I20*-I25*	N/A
Atrial fibrillation	I48*	N/A
Cardiac insufficiency	I50*	N/A
Diabetes mellitus	E10*-E14*	A10A*, A10B*
Atherosclerosis	I70*	N/A
Cancer	C00*-C99**, D00*-D09*	L01* (except L01BA01)
COPD and asthma	J44*-J46*	R03*
Dementia	F00*-F03*, G30*	N06D*
Depression	F32*-F34*	N06A*
Parkinson's disease	G20*	N04B*
Mental disorders	F20*-F31*	N05A* (except N05AB01 and N05AB04), and no dementia
Stroke (used for AMI /ACS and hip fracture)	I60*, I61*, I63*, I64*, G45*	N/A

N/A = not available

Table 3. Risk-adjustment models

Model	Availability
M1: age, sex, type of disease (specific disease, e.g. type of AMI, ACS and type of hip fracture).	CPH 2014, HEL 2009-2014, OSL 2009-2013/2014, STO 2009-2014
M2: M1 + number of days in different care arrangements 90 days before index day (acute hospital days, other institutional days, days at home with help).	CPH 2014, HEL 2009-2014, OSL 2009-2013/2014
M3: M1 + comorbidity using data from previous year, use of hospital care and prescribed medicine.	CPH 2014, HEL 2009-2014, STO July 2011-2014
M4: M1 + additional variables of M2 and M3.	CPH 2014, HEL 2009-2014

5 Acute myocardial infarction and acute coronary syndrome

5.1 Patient structure

The number of incident AMI and ACS patients varied considerably between the areas. The age- and sex-standardised number of AMI patients per 10 000 people in the Helsinki area was 7.0 (varying over the years from 6.5 to 8.2), in Copenhagen 14.3 (2014) and in Oslo 19.9 (17.6–22.7) and in Stockholm 13.9 (11.9–15.1). Corresponding figures for ACS were 8.0 (7.4–9.3) in the Helsinki area, 17.5 in Copenhagen, 23.7 (21.3–27.1) in Oslo and 15.4 (13.8–17.2) in Stockholm. The main reason for the low incidence in the Helsinki area was that the sample included only patients treated at Helsinki University Hospital, which is the only acute care hospital in the area. However, AMI/ACS patients are also treated in health centres throughout the area. These patients were excluded from the data since the units also treat long-term care patients and the index day cannot be reliably defined for them.

The differences in the selection of patients were also reflected in the age structure of the samples. The patients were older in Oslo and Stockholm compared to the Helsinki area and Copenhagen (Appendix, Tables 1 and 2). The share of STEMI (ST-Elevation Myocardial Infarction) patients was highest in the Helsinki area. During the 90-day period before the index day, the patients in Oslo had more inpatient days in other institutions (rehabilitation and long-term care institutions) than in the Helsinki area and Copenhagen. In Oslo and Copenhagen, the patients received more home help compared to Helsinki before the index day. Thus, risk- adjustment is necessary for meaningful comparison.

5.2 Mortality

Unadjusted mortality figures were lower in Copenhagen and the Helsinki area compared to the other areas. When mortality was compared separately by age for patients over and below 75 years of age, the rates were still somewhat lower in the Helsinki area and Copenhagen (Figure 2). Using model 1 for risk adjustment, mortality (30-day, 90-day and one-year) figures were highest in Stockholm, and with most of them, the difference was significant compared to Copenhagen based on non-cutting confidence intervals (Tables 4 and 5). Most of the risk-adjusted figures were not significantly different between Copenhagen, the Helsinki area and Oslo. When risk adjustment was made using model 2, 30-day mortality figures were lower in Copenhagen and Oslo than in the Helsinki area. However, when comorbidities were also used as additional risk factors (model 4) the difference between the Helsinki area and Copenhagen was no longer significant. Ninety-day mortality was also significantly higher in the Helsinki area compared to Copenhagen when risk- adjustment was performed using model 4. In Stockholm and Oslo, 30-day and one-year mortality were quite stable during the study period, whereas in the Helsinki area a clear decrease occurred between the years 2009 and 2011 (Figure 3).

5.3 Use and cost of services

The use and structure of out-patient doctor services varied between the areas. The total number of GP visits per patient during the one-year follow-up was clearly higher in Oslo (8 visits) and Copenhagen (6–7 visits) than in Stockholm (4–5 visits) and the Helsinki area (2–3 visits). The risk-adjusted figures did not change the ranking between the areas (Tables 4 and 5). Less use of GP services was compensated for by relatively more use of other doctor visits in Stockholm and the Helsinki area compared to Oslo. But in Copenhagen the use of other doctor visits was clearly higher than in other areas because of a heavy use of hospital outpatient services. The most substantial change during the study period was the increase in the number of GP visits in Oslo (Figure 4).

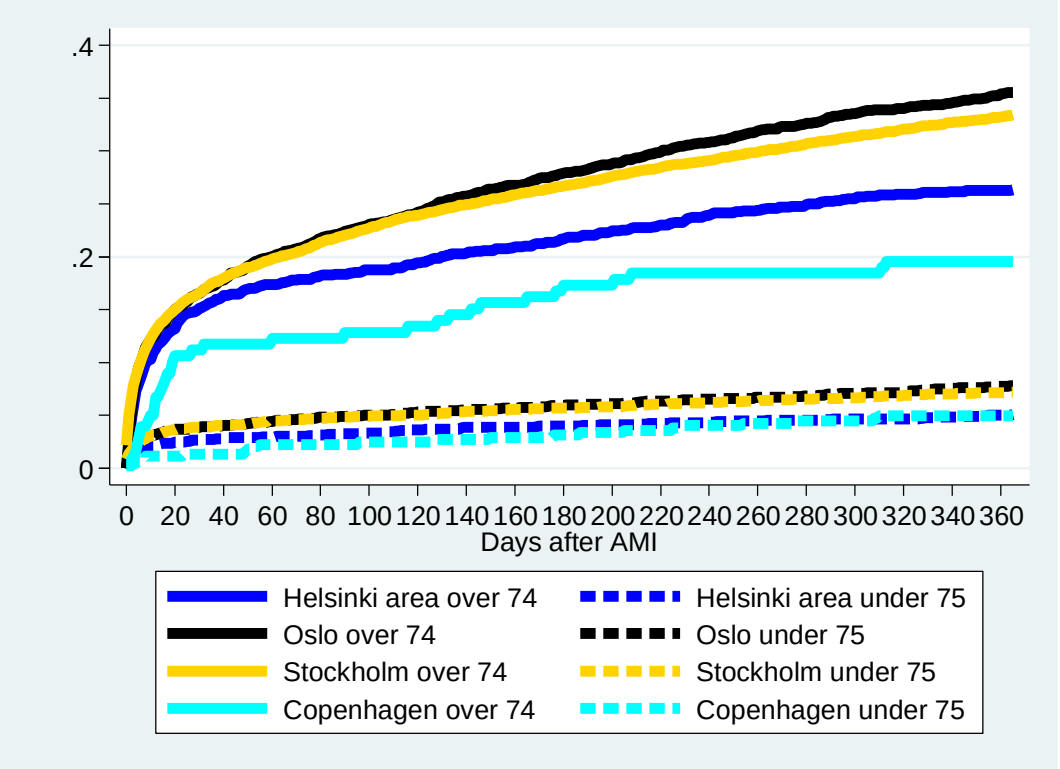

Figure 2. Daily share of patients who died after index day, AMI patients.

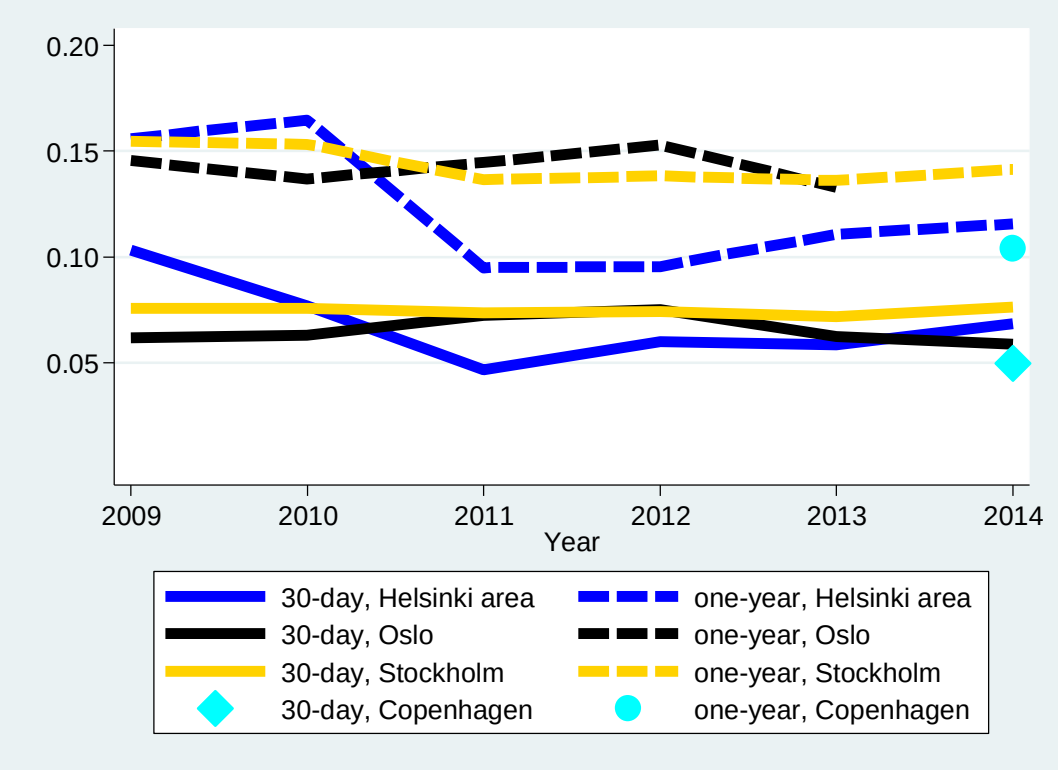

Figure 3. Risk-adjusted (model 1) 30-day and one-year mortality, 2009–2014, AMI patients.

Table 4. Risk-adjusted performance indicators, AMI patients[#]

	Copenhagen 2014 (n=622)			Helsinki area 2009-2014 (n=3604)			Oslo 2009-2013/2014 (n=5491-6209)			Stockholm 2009/2011-2014 (n=9978-17776)		
	Value	min95	max95	Value	min95	max95	Value	min95	max95	Value	min95	max95
30 -day mortality												
Model 1	0.049	0.031	0.068	0.068	0.060	0.076	0.064	0.059	0.068	0.073	0.070	0.077
Model 2	0.042	0.027	0.058	0.068	0.060	0.076	0.053	0.049	0.057			
Model 3	0.051	0.032	0.070	0.068	0.060	0.076				0.080	0.075	0.085
Model 4	0.048	0.030	0.066	0.068	0.060	0.076						
90-day mortality												
Model 1	0.057	0.039	0.076	0.083	0.074	0.091	0.087	0.081	0.092	0.095	0.091	0.098
Model 2	0.046	0.032	0.061	0.083	0.075	0.091	0.072	0.068	0.077			
Model 3	0.059	0.040	0.078	0.083	0.075	0.091				0.102	0.097	0.107
Model 4	0.052	0.035	0.069	0.083	0.075	0.091						
One-year mortality												
Model 1	0.109	0.082	0.135	0.122	0.112	0.132	0.138	0.131	0.144	0.142	0.138	0.146
Model 2	0.091	0.070	0.113	0.122	0.112	0.132	0.121	0.115	0.126			
Model 3	0.112	0.086	0.139	0.122	0.112	0.132				0.160	0.173	0.151
Model 4	0.104	0.080	0.129	0.122	0.112	0.131						
Length of first acute hospital admission												
Model 1	9.0	8.2	9.8	8.4	8.2	8.7	7.1	7.0	7.3	6.2	6.2	6.3
Model 2	8.5	7.8	9.2	8.4	8.2	8.7	7.3	7.2	7.5			
Model 3	9.1	8.3	9.9	8.4	8.2	8.7				6.0	5.9	6.1
Model 4	8.7	7.9	9.4	8.4	8.2	8.7						
Length of first acute hospital and rehabiltation admissions												
Model 1	10.4	9.4	11.4	10.2	11.0	10.5	11.2	10.8	11.6	7.5	7.3	7.6
Model 2	8.6	7.8	9.5	10.1	10.9	10.6	10.1	9.7	10.5			
Model 3	10.3	9.3	11.3	10.2	11.0	10.5				7.3	7.2	7.5
Model 4	8.8	7.9	9.6	10.1	10.9	11.8						
Length of first institutional episode												
Model 1	12.6	11.1	14.1	11.8	11.3	12.3	13.8	13.3	14.3			
Model 2	10.3	9.2	11.4	11.7	11.2	12.2	10.5	10.2	10.8			
Model 3	12.3	10.9	13.8	11.8	11.3	12.3						
Model 4	10.3	9.2	11.5	11.7	11.2	12.1						
Number of days in acute hospital care, one year												
Model 1	13.0	11.8	14.2	11.8	11.3	12.2	9.6	9.4	9.9	10.6	10.5	10.8
Model 2	11.8	10.7	12.8	11.6	11.1	12.1	9.9	9.6	10.2			
Model 3	13.1	12.0	14.3	11.8	11.3	12.2				10.1	9.9	10.3
Model 4	12.4	11.3	13.5	11.7	11.2	12.1						
Number of inpatient days, one year												
Model 1	24.0	19.7	28.2	23.6	22.0	25.2	29.0	27.4	30.5			
Model 2	12.5	17.2	21.6	22.1	20.5	23.7	15.1	14.4	15.8			
Model 3	21.6	17.7	25.5	23.1	21.6	24.7						
Model 4	15.5	13.0	17.9	22.2	20.7	23.8						
Number of GP visits ,one year												
Model 1	5.8	5.3	6.3	2.6	2.5	2.7	8.1	7.8	8.3	4.5	4.4	4.6
Model 2	6.2	5.7	6.7	2.6	2.5	2.7	8.6	8.4	8.9			
Model 3	5.9	5.4	6.4	2.6	2.5	2.7				4.5	4.3	4.6
Model 4	6.4	5.9	7.0	2.6	2.5	2.7						
Number of other doctor visits,one year												
Model 1	13.0	11.9	14.1	6.7	6.2	7.1	1.5	1.4	1.6	6.8	6.7	7.0
Model 2	12.3	11.2	13.4	6.6	6.1	7.0	1.5	1.4	1.6			
Model 3	13.2	12.1	14.4	6.7	6.2	7.1				6.5	6.2	6.7
Model 4	13.2	12.0	14.3	6.7	6.2	7.1						
Number of home help visits, one year												
Model 1	42.8	29.2	56.3	21.0	18.1	23.8	39.1	36.2	42.0			
Model 2	14.2	10.1	18.3	21.0	18.5	23.4	16.6	15.4	17.8			
Model 3	40.9	27.8	54.0	21.0	18.2	23.8						
Model 4	14.4	10.2	18.5	21.0	18.5	23.4						
Cost of first acute hospital episode												
Model 1	9265	8497	10033	9861	9573	10149	7289	7135	7443	6747	6657	6837
Model 2	8977	8240	9714	9848	9563	10134	7628	7465	7791			
Model 3	9359	8585	10134	9861	9574	10147				6455	6343	6567
Model 4	9059	8318	9800	9848	9563	10133						
Cost of first acute and rehabilitation hospital episode												
Model 1	9574	8767	10380	10353	10049	10656	8280	8089	8470	7128	7033	7224
Model 2	8998	8252	9745	10329	10027	10630	8397	8201	8592			
Model 3	9637	8828	10446	10350	10049	10652				6758	6640	6875
Model 4	9066	8316	9815	10326	10025	10627						
Cost of first institutional episode												
Model 1	9961	9121	10800	10592	10281	10902	8902	8699	9104			
Model 2	9326	8560	10092	9981	10262	10877	8618	8431	8805			
Model 3	9981	9141	10821	10588	10279	10897						
Model 4	9389	8620	10157	10588	10279	10897						
One-year cost												
Model 1	24731	22781	26682	19563	18883	20243	20063	19437	20688			
Model 2	18803	17375	20230	19207	18499	19914	15196	14760	15632			
Model 3	24422	22489	26356	19505	18846	20165						
Model 4	19863	18366	21361	19269	18602	19937						

[#] Risk adjustment variables includes also year indicators

Table 5. Risk-adjusted performance indicators, ACS patients[#]

	Copenhagen 2014 (n=741)			Helsinki area 2009-2014 (n=4129)			Oslo 2009-2012/2014 (n=6548/7457)			Stockholm 2009/2011-2014 (n=20366)		
	Value	min95	max95	Value	min95	max95	Value	min95	max95	Value	min95	max95
30 -day mortality												
Model 1	0.047	0.030	0.065	0.062	0.055	0.069	0.056	0.052	0.060	0.067	0.064	0.070
Model 2	0.039	0.025	0.054	0.062	0.055	0.069	0.046	0.043	0.050			
Model 3	0.048	0.030	0.066	0.062	0.055	0.069				0.071	0.067	0.076
Model 4	0.044	0.028	0.061	0.062	0.055	0.069						
90-day mortality*												
Model 1	0.054	0.037	0.071	0.077	0.069	0.084	0.078	0.073	0.083	0.087	0.084	0.090
Model 2	0.043	0.029	0.056	0.077	0.069	0.084	0.064	0.060	0.068			
Model 3	0.055	0.037	0.072	0.077	0.069	0.084				0.091	0.086	0.096
Model 4	0.048	0.033	0.063	0.077	0.069	0.084						
One-year mortality												
Model 1	0.109	0.084	0.134	0.113	0.104	0.122	0.126	0.120	0.132	0.132	0.128	0.135
Model 2	0.087	0.068	0.107	0.113	0.104	0.122	0.108	0.103	0.113			
Model 3	0.110	0.086	0.135	0.113	0.105	0.122				0.138	0.133	0.143
Model 4	0.100	0.078	0.122	0.113	0.105	0.122						
Length of first acute hospital episode												
Model 1	9.8	9.1	10.4	8.2	8.0	8.5	6.7	6.5	6.8	6.2	6.2	6.3
Model 2	9.2	8.6	9.9	8.2	8.0	8.4	6.8	6.7	7.0			
Model 3	9.8	9.1	10.5	8.2	8.0	8.5				6.0	5.9	6.1
Model 4	9.4	8.7	10.0	8.2	8.0	8.5						
Length of first acute hospital and rehabilitation episode												
Model 1	11.3	10.4	12.2	10.2	9.8	10.6	11.2	10.8	11.6	7.4	7.6	7.6
Model 2	9.4	8.6	10.1	10.1	9.7	10.5	10.1	9.7	10.5			
Model 3	11.2	10.3	12.1	10.2	9.8	10.6				7.3	7.2	7.4
Model 4	9.5	8.7	10.2	10.1	9.7	10.5						
Length of first institutional episode												
Model 1	13.7	12.3	15.1	11.4	10.9	11.8	13.8	13.3	14.3			
Model 2	10.8	9.8	11.7	11.2	10.8	11.6	10.5	10.2	10.8			
Model 3	13.3	11.9	14.6	11.3	10.9	11.8						
Model 4	10.8	9.9	11.8	11.2	10.7	11.6						
Number of days in acute hospital care, one year												
Model 1	14.3	13.2	15.4	11.6	11.2	12.0	9.0	8.8	9.2	10.5	10.4	10.7
Model 2	13.0	12.0	14.0	11.4	10.9	11.9	9.2	9.0	9.5			
Model 3	14.3	13.2	15.4	11.6	11.2	12.0				10.0	9.8	10.2
Model 4	13.6	12.6	14.6	11.5	11.1	11.9						
Number of inpatient days, one year												
Model 1	26.0	21.8	30.1	22.9	21.4	24.4	27.1	25.7	28.4			
Model 2	15.2	13.1	17.3	21.4	19.9	23.0	14.1	13.5	14.7			
Model 3	23.2	19.4	27.0	22.4	21.0	23.9						
Model 4	15.9	13.6	18.2	21.5	20.0	23.0						
Number of GP visits ,one year												
Model 1	6.7	6.2	7.1	2.7	2.6	2.8	8.5	8.2	8.7	4.6	4.5	4.7
Model 2	7.0	6.5	7.5	2.7	2.6	2.8	8.5	8.2	8.7			
Model 3	6.6	6.2	7.1	2.7	2.6	2.8				4.6	4.4	4.7
Model 4	7.2	6.7	7.7	2.7	2.6	2.8						
Number of other doctor visits,one year												
Model 1	15.3	14.2	16.5	6.6	6.2	7.0	1.5	1.4	1.6	6.9	6.7	7.1
Model 2	15.0	13.8	16.1	6.5	6.1	6.9	1.6	1.5	1.7			
Model 3	15.2	14.1	16.4	6.6	6.2	7.0				6.5	6.3	6.7
Model 4	15.6	14.3	16.8	6.6	6.2	7.0						
Number of home help visits, one year												
Model 1	46.7	33.2	60.2	19.8	17.2	22.3	37.1	34.4	39.8			
Model 2	14.0	10.4	17.7	19.8	17.6	22.0	15.8	14.6	16.9			
Model 3	43.0	30.5	55.5	19.8	17.3	22.3						
Model 4	14.1	10.5	17.8	19.8	17.6	22.0						
Cost of first acute hospital episode												
Model 1	10765	10066	11463	9717	9436	9998	6736	6601	6872	6909	6820	6998
Model 2	10425	9750	11101	9702	9425	9980	7048	6904	7191			
Model 3	10853	10151	11556	9717	9437	9996				6480	6372	6587
Model 4	10506	9828	11184	9701	9424	9977						
Cost of first acute and rehabilitation hospital episode												
Model 1	11128	10395	11860	10162	9869	10456	7220	7051	7389	7194	7102	7287
Model 2	10440	9757	11123	10133	9842	10424	7282	7113	7451			
Model 3	11174	10441	11907	10160	9868	10452				6784	6671	6897
Model 4	10493	9810	11176	10128	9838	10419						
Cost of first institutioina l episode												
Model 1	11583	10818	12347	10398	10098	10698	7638	7470	7807			
Model 2	10754	10057	11450	10370	10074	10666	7744	7572	7916			
Model 3	11577	10813	12341	10394	10096	10693						
Model 4	10805	10108	11503	10363	10068	10658						
One-year cost												
Model 1	27813	26006	29620	18978	18358	19599	18530	17978	19082			
Model 2	20899	19520	22277	18599	17945	19254	14124	13741	14507			
Model 3	27121	25335	28908	18919	18317	19522						
Model 4	21902	20474	23331	18679	18070	19288						

[#] Risk adjustment variables includes also year indicators

The unadjusted number of home help visits during the one-year follow-up was clearly higher in Oslo and Copenhagen compared to the Helsinki area. However, the risk-adjusted figures were dependent on the variables used for risk-adjustment. Age- and sex-based risk adjustment (model 1) decreased the difference in the number of visits between Oslo and Helsinki from 36–41 visits to 17–18 visits, but when the use of various services (including home help) during the 90-day period before the index day were also adjusted for (model 2), the number of home help visits was smaller in Oslo and Copenhagen (also model 4) compared to the Helsinki area. The two adjustment models even gave a somewhat different picture of the trends in home help visits in Oslo (Figure 5).

The length of stay during the first acute hospital episode in the Helsinki area and Copenhagen was several days longer than in Oslo and Stockholm. Copenhagen was the only area where ACS patients remained in acute care longer than AMI patients. When rehabilitation admissions were also taken into account, the difference between the Helsinki area/Copenhagen and Oslo decreased (Tables 4 and 5). The length of stay during the first acute episode was, in 2009, at about the same level in the Helsinki area as in Oslo, but afterwards the measure increased in the Helsinki area until the year 2012, whereas in Oslo the measure showed a decreasing trend (Figure 6). In Stockholm, both the length of stay during the first acute episode and the first episode, including rehabilitation, were lowest throughout the whole study period.

When hospital days also included long-term inpatient care (e.g. nursing homes), the results varied according to the risk-adjustment method. The unadjusted number of all inpatient days both during the first institutional episode and one-year follow-up were higher in Oslo than in Helsinki and Copenhagen. Risk-adjustment using model 1 equalised the difference between the areas, whereas using risk-adjustment model 2 gave a higher number of days in the Helsinki area compared to Oslo and Copenhagen.

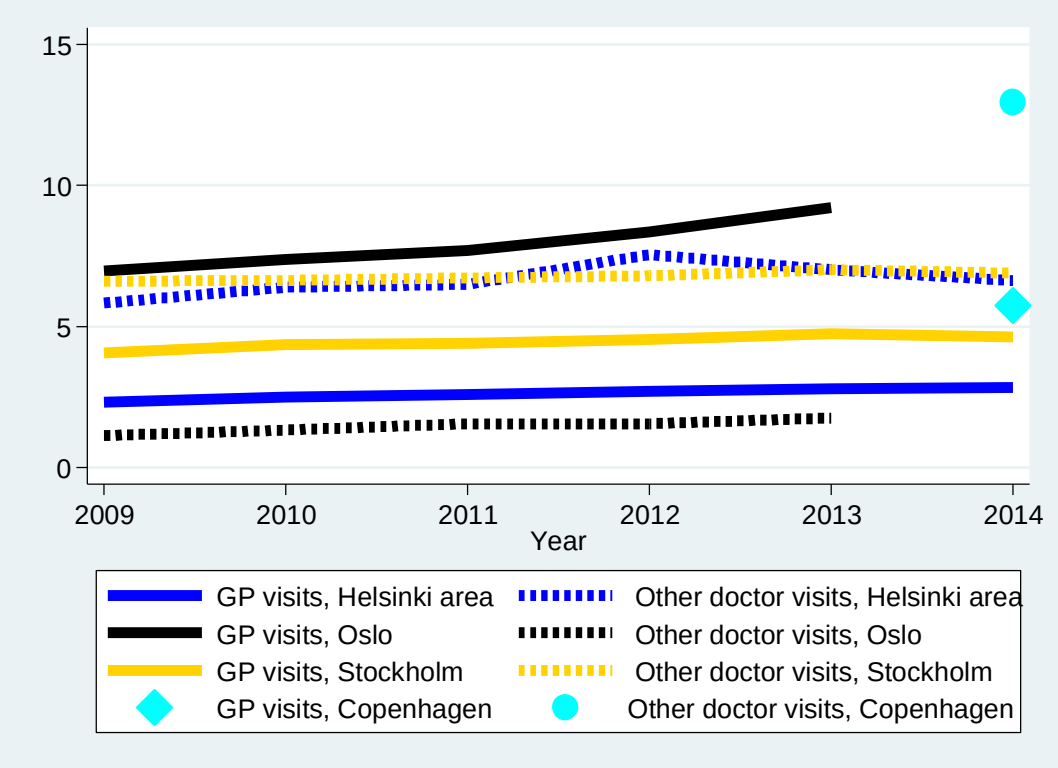

Figure 4. Risk-adjusted (model 1) number of visits to a doctor during one year after AMI.

Unadjusted cost figures during the first institutional episode were higher in the Helsinki area than in Oslo Copenhagen for AMI patients. Among ACS patients, these cost figures were about the same in Copenhagen as in the Helsinki area. However, the unadjusted and adjusted (model 1) one-year total costs were highest in Copenhagen, reflecting a greater use of acute care and outpatient hospital services. Again, especially the one-year total cost estimates varied according to the risk-adjustment method used. When model 1 was used for risk-adjustment, the one-year total costs in 2009 were higher in Oslo compared to Helsinki, but afterwards they increased in the Helsinki area and decreased in Oslo (Figure 7). This increase in Helsinki seems to be related to an increase in the use of acute hospital care during the first hospital episode.

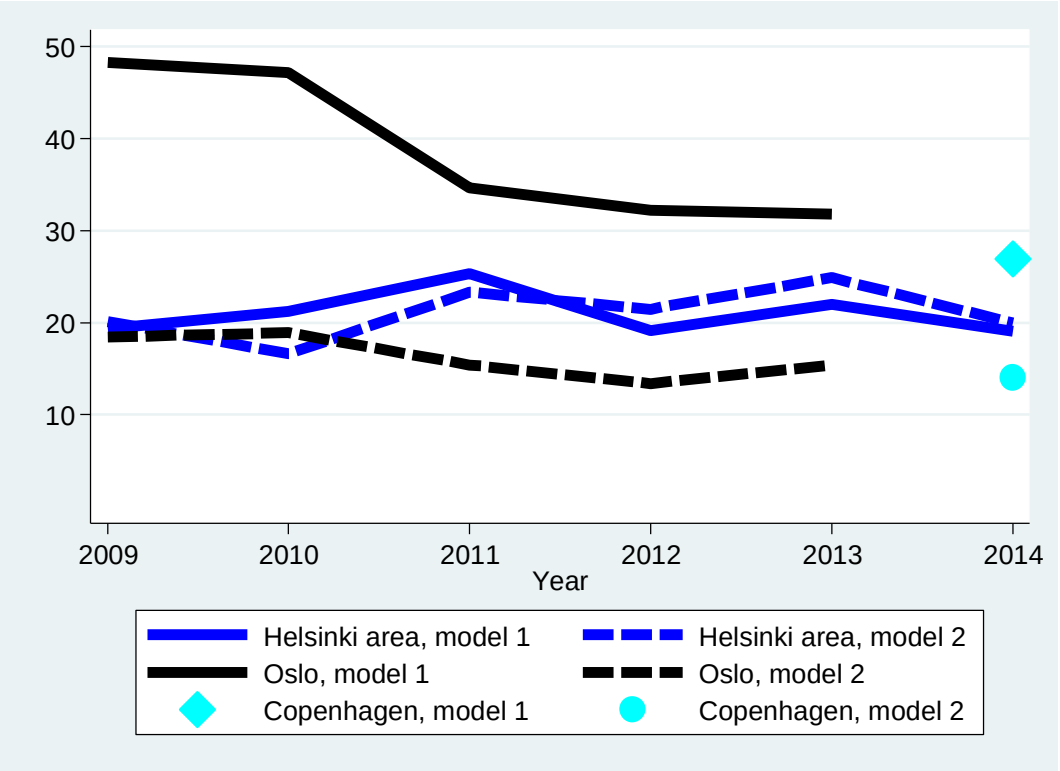

Figure 5. Number of home help visits (one year) using two risk- adjustment models, AMI patients.

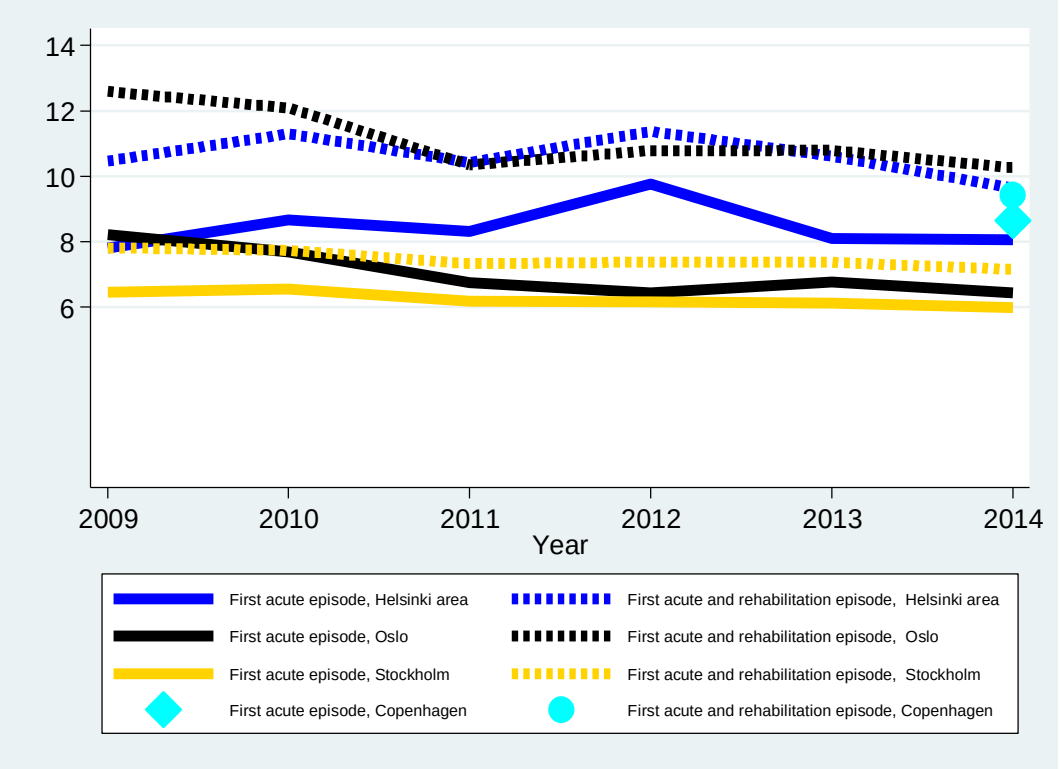

Figure 6. Risk-adjusted (model 1) length of stay during first acute hospital episode with and without rehabilitation, AMI patients.

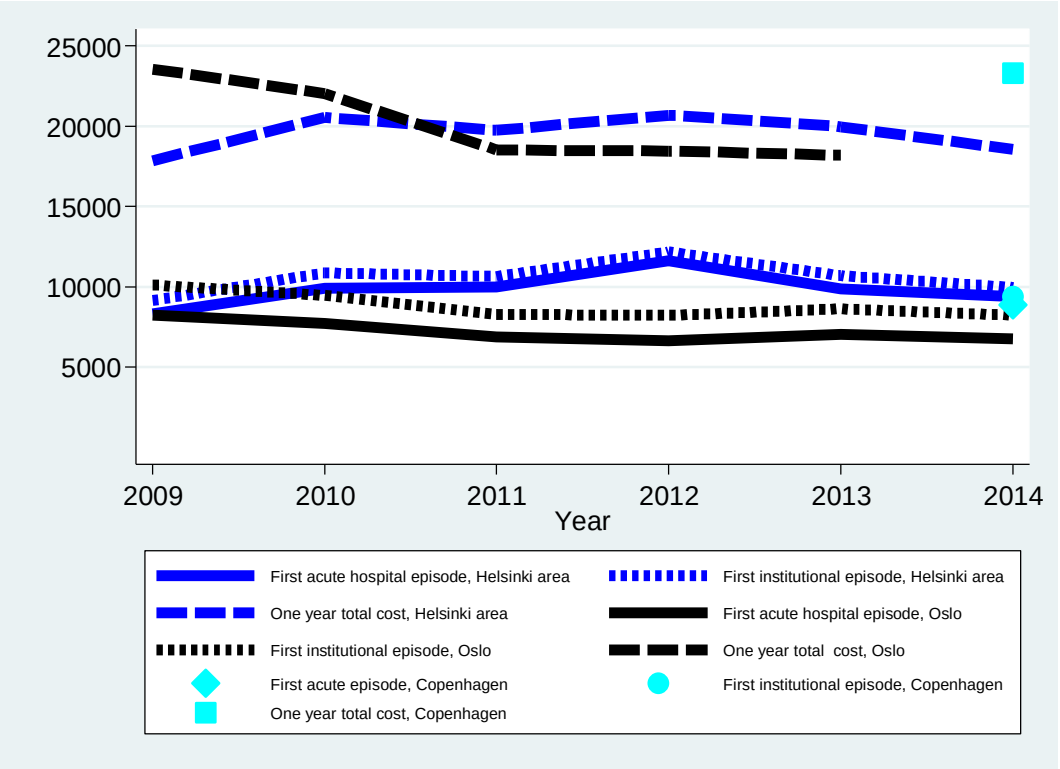

Figure 7. Risk-adjusted (model 1) cost during the first hospital episode and for one year, AMI patients.

6 Ischemic stroke

6.1 Patient structure

The number of incident ischemic stroke patients varied between the areas considerably less than the number of AMI and ACS patients. The age- and sex-standardised number of ischemic patients per 10 000 people was in the Helsinki area 10.4 (varying over the years between 9.2 and 11.3), in Stockholm 15.6 (13.7–16.7), in Copenhagen 9.0 (2014) and in Oslo 14.0 (13.2–14.6). As for AMI patients, the patients were older in Oslo and Stockholm compared to the Helsinki area and Copenhagen (Appendix Table 3). In addition, the share of patients who were in hospital or long-term care during all 90 days before the index day was higher in Oslo (11%) Copenhagen (7%) compared to the Helsinki area (1%).

6.2 Mortality

Unadjusted 30-day mortality rates were higher in Oslo and Stockholm than in the Helsinki area and Copenhagen (Appendix Table 4). Especially among patients over 74 years of age, the mortality rates were higher in these two cities compared to Copenhagen (first 60 days) and the Helsinki area during the whole year follow-up period (Figure 8). Age- and gender-standardised 30-day mortality was highest in Stockholm, and the difference when compared to the Helsinki area was significant. When adjusting for the previous use of services before the index day (model 2), the three mortality indicators were even somewhat lower in Oslo and Copenhagen than in the Helsinki area (Table 6). When comorbidity was used for risk-adjustment (model 3), the difference between Copenhagen, the Helsinki area and Stockholm was not significant. The mortality figures were rather stable during the study period; while only in the Helsinki area did the one-year mortality vary between the years (Figure 9).

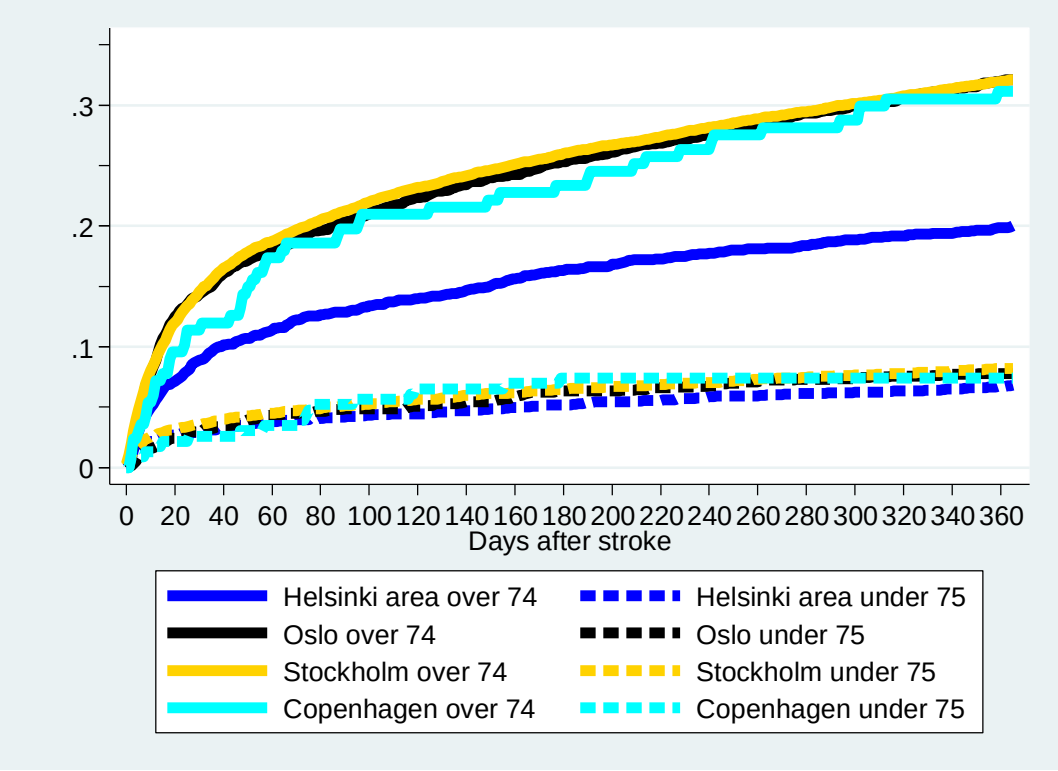

Figure 8. Daily share of patients who died after index day, ischemic stroke patients.

Table 6. Risk adjusted performance indicators, ischemic stroke[#]

	Copenhagen 2014 (n=397)			Helsinki area 2009-2014 (n=5350)			Oslo 2009-2013/2014 (n=3776-4289)			Stockholm 2009/2011-2014 (n=11632-20404)		
	Value	min95	max95	Value	min95	max95	Value	min95	max95	Value	min95	max95
30 -day mortality												
Model 1	0.057	0.036	0.078	0.054	0.048	0.060	0.064	0.059	0.070	0.068	0.066	0.071
Model 2	0.034	0.022	0.047	0.054	0.048	0.060	0.045	0.041	0.049			
Model 3	0.059	0.037	0.082	0.054	0.048	0.060				0.062	0.058	0.065
Model 4	0.039	0.024	0.053	0.054	0.048	0.060						
90-day mortality												
Model 1	0.119	0.087	0.150	0.077	0.070	0.084	0.092	0.085	0.099	0.101	0.098	0.105
Model 2	0.069	0.051	0.088	0.077	0.070	0.084	0.066	0.061	0.070			
Model 3	0.122	0.090	0.155	0.077	0.070	0.084				0.090	0.086	0.093
Model 4	0.078	0.057	0.099	0.077	0.070	0.084						
One-year mortality												
Model 1	0.188	0.150	0.227	0.122	0.114	0.131	0.152	0.143	0.160	0.160	0.156	0.164
Model 2	0.108	0.086	0.130	0.122	0.114	0.130	0.110	0.104	0.116			
Model 3	0.203	0.161	0.244	0.122	0.114	0.130				0.156	0.151	0.161
Model 4	0.124	0.099	0.150	0.122	0.114	0.130						
Share of patients discharged home (total)within 90 days												
Model 1	0.693	0.652	0.734	0.768	0.757	0.779	0.743	0.729	0.757			
Model 2	0.802	0.757	0.846	0.768	0.757	0.778	0.859	0.846	0.873			
Model 3	0.695	0.654	0.736	0.769	0.758	0.780						
Model 4	0.793	0.749	0.836	0.768	0.757	0.778						
Share of patients discharged home (without help) within 90 days												
Model 1	0.524	0.482	0.566	0.652	0.640	0.664	0.603	0.588	0.618			
Model 2	0.693	0.647	0.740	0.652	0.641	0.664	0.731	0.717	0.746			
Model 3	0.523	0.482	0.564	0.652	0.640	0.664						
Model 4	0.691	0.645	0.737	0.652	0.641	0.664						
Share of patients institutionalised (90 days)												
Model 1	0.143	0.109	0.177	0.125	0.117	0.134	0.134	0.125	0.144			
Model 2	0.099	0.077	0.121	0.125	0.117	0.134	0.092	0.086	0.098			
Model 3	0.140	0.108	0.173	0.127	0.118	0.135						
Model 4	0.097	0.076	0.119	0.125	0.117	0.134						
Share of patients institutionalised (one year)												
Model 1	0.059	0.037	0.081	0.041	0.036	0.047	0.072	0.065	0.079			
Model 2	0.032	0.021	0.044	0.041	0.036	0.046	0.035	0.032	0.038			
Model 3	0.055	0.035	0.076	0.041	0.036	0.047						
Model 4	0.030	0.019	0.041	0.041	0.036	0.046						
Length of first acute hospital episode												
Model 1	14.7	13.0	16.5	9.6	9.5	9.8	13.6	13.2	14.0	7.8	7.7	7.9
Model 2	15.4	13.6	17.3	9.6	9.5	9.8	14.2	13.8	14.6			
Model 3	14.4	12.7	16.1	9.6	9.5	9.8				7.9	7.7	8.0
Model 4	15.5	13.7	17.4	9.6	9.5	9.8						
Length of first acute hospital and rehabilitation episode												
Model 1	15.4	13.4	17.4	20.1	19.5	20.7	22.2	21.5	22.9	14.0	13.8	14.2
Model 2	13.9	12.2	15.7	20.1	19.5	20.7	21.4	20.7	22.1			
Model 3	15.3	13.3	17.3	20.1	19.5	20.7				14.1	13.8	14.4
Model 4	13.9	12.1	15.7	20.1	19.5	20.7						
Length of first institutional episode												
Model 1	24.9	21.8	27.9	25.3	24.5	26.1	26.1	25.3	26.9			
Model 2	20.1	17.7	22.4	25.3	24.5	26.1	21.4	20.8	22.0			
Model 3	25.3	22.2	28.4	26.0	25.2	26.8						
Model 4	19.8	17.5	22.1	25.3	24.5	26.1						
Number of days in acute hospital care, one year												
Model 1	17.85	15.79	19.90	11.9	11.6	12.2	15.6	15.1	16.1	11.9	11.8	12.1
Model 2	18.50	16.35	20.66	11.9	11.6	12.2	16.6	16.1	17.0			
Model 3	17.33	15.33	19.33	11.5	11.2	11.8				11.9	11.7	12.1
Model 4	17.33	15.33	19.33	11.9	11.6	12.2						
Number of inpatient days, one year												
Model 1	40.64	34.18	47.11	56.0	53.6	58.5	38.2	36.4	40.0			
Model 2	26.59	22.48	30.70	56.8	54.4	59.2	25.4	24.3	26.5			
Model 3	41.11	34.61	47.61	56.8	54.4	59.2						
Model 4	26.92	22.72	31.11	55.6	53.2	57.9						
Number of GP visits ,one year												
Model 1	8.19	7.49	8.89	2.6	2.5	2.7	6.4	6.1	6.7	5.9	5.8	6.0
Model 2	9.03	8.20	9.87	2.6	2.5	2.7	6.7	6.4	7.0			
Model 3	8.57	7.83	9.30	2.7	2.6	2.8				6.3	6.1	6.4
Model 4	9.48	8.58	10.37	2.6	2.5	2.7						
Number of other doctor visits,one year												
Model 1	8.97	7.98	9.97	6.9	6.6	7.2	2.8	2.5	3.0	6.2	6.6	6.4
Model 2	9.13	8.08	10.17	6.9	6.6	7.2	3.0	2.7	3.3			
Model 3	9.33	8.30	10.36	6.9	6.6	7.2				6.8	6.6	7.0
Model 4	9.73	8.64	10.83	6.9	6.6	7.2						
Number of home help visits, one year												
Model 1	113.5	71.4	155.6	32.3	29.3	35.2	70.7	64.9	76.5			
Model 2	40.0	25.8	54.2	27.0	24.6	29.4	32.9	30.2	35.6			
Model 3	133.9	84.6	183.2	39.3	35.7	42.9						
Model 4	41.7	27.0	56.5	32.3	29.4	35.1						
Cost of first acute hospital episode												
Model 1	13021	11468	14575	8518	8355	8680	12042	11710	12374	6912	6820	7004
Model 2	13652	12013	15290	8559	8396	8722	12666	12315	13017			
Model 3	12755	11240	14271	8336	8178	8495				6960	6838	7081
Model 4	13745	12100	15390	8517	8355	8679						
Cost of first acute and rehabilitation hospital episode												
Model 1	12778	11271	14286	10823	10660	11113	13909	13542	14276	8286	8185	8387
Model 2	12489	11025	13954	10995	10766	11224	14144	13770	14518			
Model 3	12595	11115	14074	10765	10541	10988				8356	8223	8490
Model 4	12486	11028	13945	10885	10658	11111						
Cost of first institutional episode												
Model 1	14912	13254	16569	11948	11697	12198	14667	14299	15035			
Model 2	13827	12306	15347	12083	11830	12336	13866	13523	14208			
Model 3	14888	13238	16537	11981	11730	12231						
Model 4	13782	12272	15292	11945	11696	12194						
One-year cost												
Model 1	40997	36682	45312	24223	23587	24859	30017	29081	30952			
Model 2	30197	27111	33284	24382	23748	25015	22942	22263	23621			
Model 3	41564	37233	45895	24619	23975	25263						
Model 4	31523	28306	34739	24160	23534	24787						

[#] Risk adjustment variables includes also year indicators

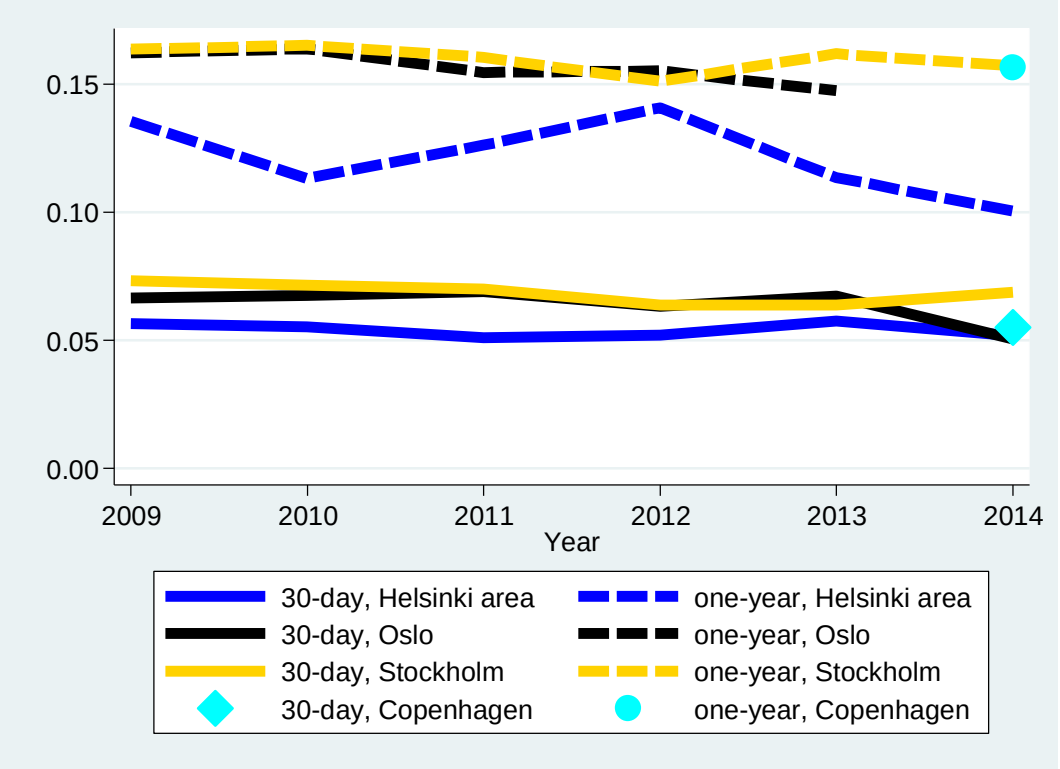

Figure 9. Risk-adjusted (model 1) for 30-day and one-year mortality, 2009–2014, ischemic stroke patients

6.3 Discharge to home

Using the state diagram we were able to describe unadjusted share of patients being at home before and after the index day. Figure 10 describes the daily share of patients over 74 years of age that were at home during one-year periods before and after the index day. Before the onset of stroke, the share was somewhat higher in the Helsinki area than in the two other cities. In the Helsinki area, patients also returned home more quickly. The picture is quite different when we consider the patients who were at home without home-help services (Figure 11). The share of patients at home without home help before stroke was clearly lower in Oslo and Copenhagen than in the Helsinki area. Use of home help services was more frequent in the two cities during 90 days prior to the index date (Appendix Table 3). For example, one week before the index day 45% of patients (over 74 years of age) in Copenhagen and 25% patients in Oslo received home help services compared to only 3% in the Helsinki area.

In the Helsinki area, the age- and sex-standardised share of patients discharged to home within 90 days was almost 8 percentage points higher than in Copenhagen and about 2 percentage points higher than in Oslo. The correspondence figure for discharges to home without help was even higher (13 and 5 percentage points) in the Helsinki area compared to Oslo and Copenhagen. However, when the differences in the utilisation of services before the onset of stroke (model 2) are taken into account (model 2), the share of patients permanently discharged to home was about 8 percentage points higher in Oslo compared to the Helsinki areas for all home discharges and about 8 percentage points higher for discharges without home help (Table 6). The adjusted shares (models 2 and 4) in Copenhagen were also somewhat higher than in the Helsinki area, but the differences were not statistically significant. During the study period, though, Oslo reached the level of the Helsinki area in age- and sex-standardised shares (Figure 12).

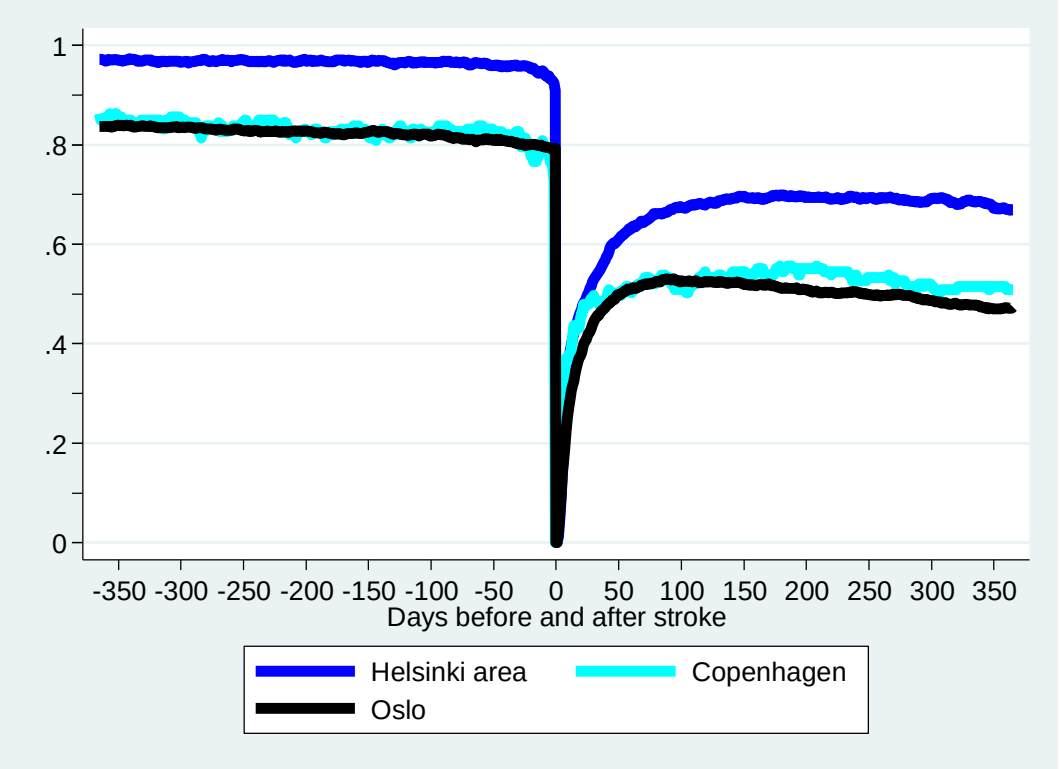

Figure 10. Daily share of patients at home before and after onset of stroke, ischemic stroke patients over 74 years of age.

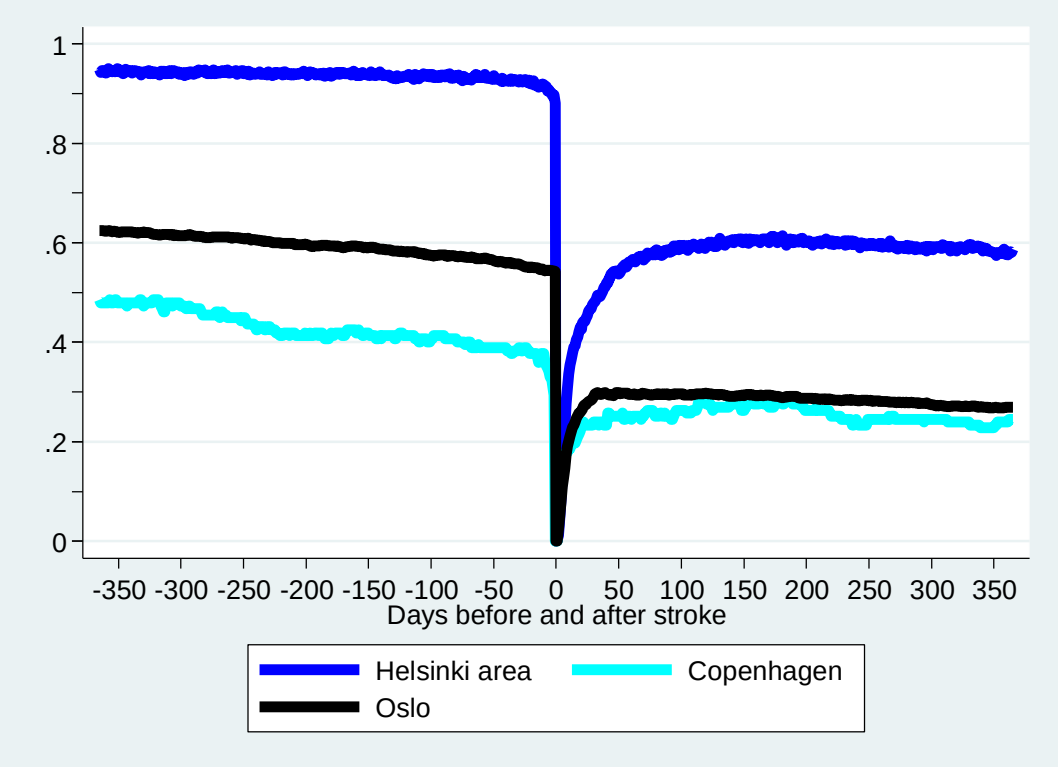

Figure 11. Daily share of patients at home without help before and after onset of stroke, ischemic stroke patients over 74 years of age.

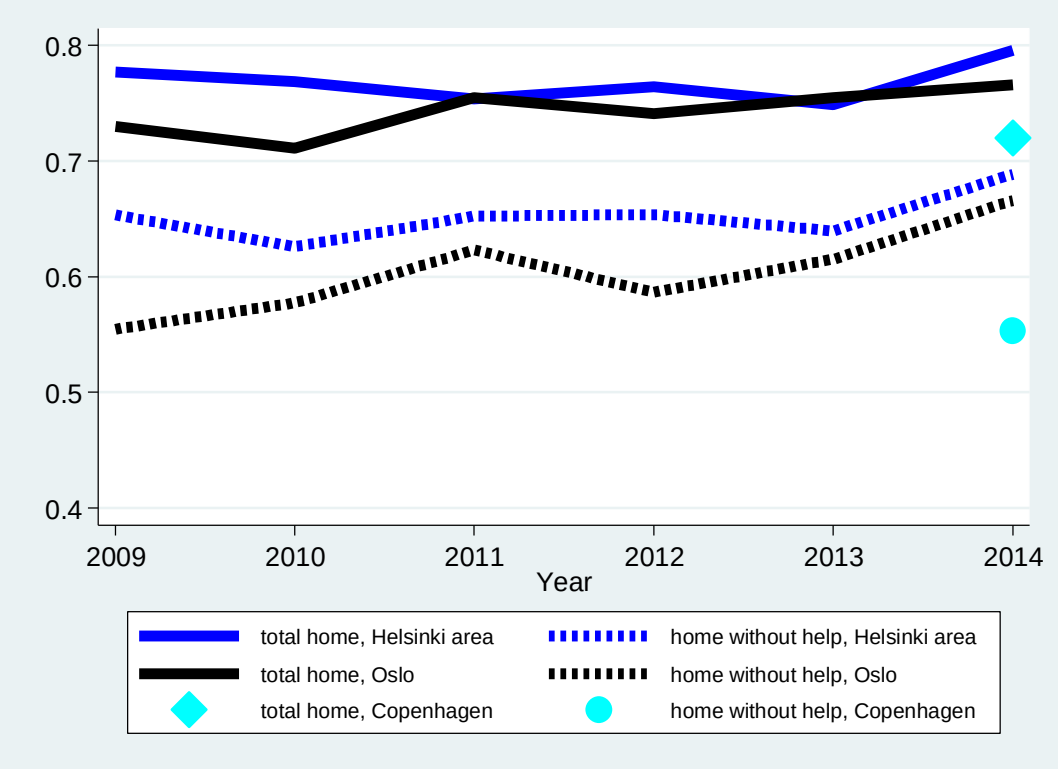

Figure 12. Risk-adjusted (model 1) share of patients discharged to home with and without home help within 90 days, ischemic stroke patients

6.4 Institutionalisation

Since the share of patients over 74 years of age at home before the onset of stroke was highest in the Helsinki area, the share of patients at institutions was lowest in the area as well (Figure 13). After the onset of stroke, the share of patients in institutions in the Helsinki area was lower than in Copenhagen and Oslo, but the differences were smaller than before the onset of the disease and the relative change in the share of patients in institutions before and after stroke was highest in the Helsinki area. This is reflected in the risk-adjusted (model 2) share of institutionalised patients after 90 days and one year after the index day (Table 6). In the Helsinki area, the 90-day share was about 3 percentage points and the one-year share about 1 percentage point higher than in Oslo and Copenhagen (insignificant). The differences between Oslo and the Helsinki area were rather stable over time, except for 2012, when there was a clear reduction in the share of 90-day institutionalisations in the Helsinki area (Figure 14).

6.5 Use and cost of services

The structural differences between the areas in the use of outpatient doctor's services was similar as with care or AMI and ACS patients, with the exception that among stroke patients, the number of GP visits were also highest in Copenhagen and the figures for Stockholm were closer to the number of visits in Oslo. Thus, the total number of all doctor visits was much higher in Copenhagen, and in Stockholm the total figures were also higher than for the two other areas. Again, the use of GP services in Oslo increased after 2009 (Figure 15). Home help services were provided more often to patients in Copenhagen and Oslo than in the Helsinki area in all risk adjustment specifications: even the figures adjusted for previous use of services (model 2) were slightly higher in Oslo and Copenhagen than in the Helsinki area (Table 6).

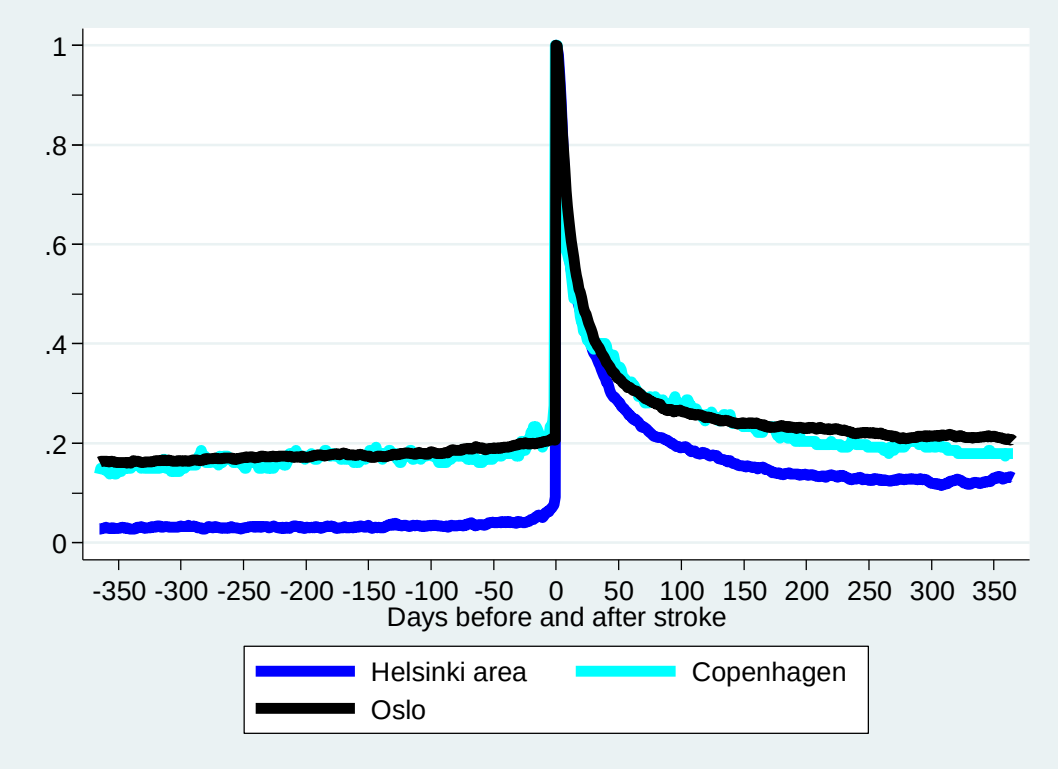

Figure 13. Daily share of patients in institutional care before and after stroke, ischemic stroke patients over 74 years of age.

The LOS of inpatient care given during the first acute episode was shortest in Stockholm. When inpatient rehabilitation was added to the first acute episode, the LOS was lowest in Stockholm and Copenhagen. In Oslo, the LOS during the first acute episode was longer than in the Helsinki area, but when rehabilitation admissions were also taken into account the difference between the Helsinki area and Oslo diminished (Table 6). In the Helsinki area, the use of care given at health centres during the first hospital episode increased after 2012. Except for this change, the annual changes in the LOS during the first acute hospital episode and the following inpatient rehabilitation period were minor in the three areas (Figure 16).

The risk-adjusted (models 1 and 2) number of all inpatient days during the first institutional episode was about the same in the three areas but the number of inpatients days during one year was lower in Oslo and Copenhagen than in the Helsinki (Table 6). But since stroke patients in Oslo and Copenhagen used more expensive acute hospital care, the adjusted cost for care during the first hospital episode were somewhat higher in the two cities compared to the Helsinki area. Again, the one-year costs were sensitive to the risk-adjusting method. Age- and sex-standardised one-year costs were over 15000 € per patient higher in Copenhagen than in the Helsinki area and 10000 € higher than in Oslo. The main reason for the higher cost in Copenhagen had to do with the greater use of acute hospital care as well as ambulatory and home help services. When model 2 was used for risk-adjustment, the difference between Copenhagen and Helsinki was reduced to 6000 € and the difference between Copenhagen and Oslo reduced to 7000 € (Table 6). During the years 2009–2013, the adjusted (model 2) total one-year costs were about 25 000 € in the Helsinki area and about the same level as in Copenhagen in 2014 (Figure 17). In 2014, they decreased in Helsinki by 5000 € per patient.

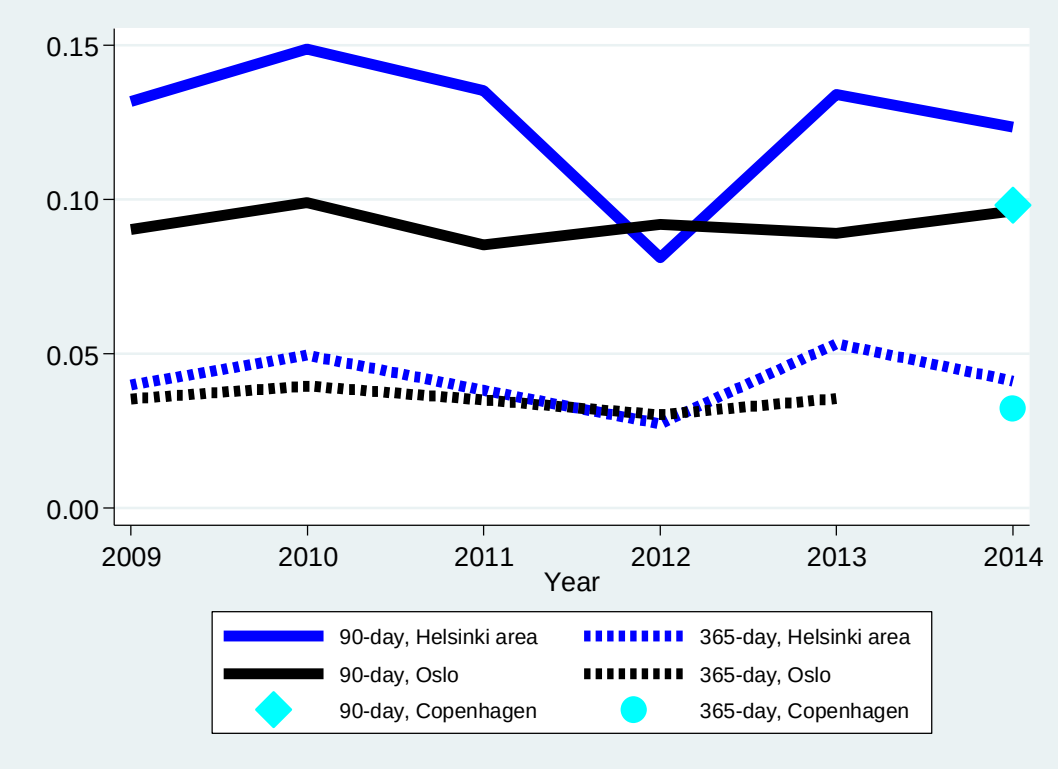

Figure 14. Risk-adjusted (model 2) share of institutionalised patients after 90 days and one year, ischemic stroke patients.

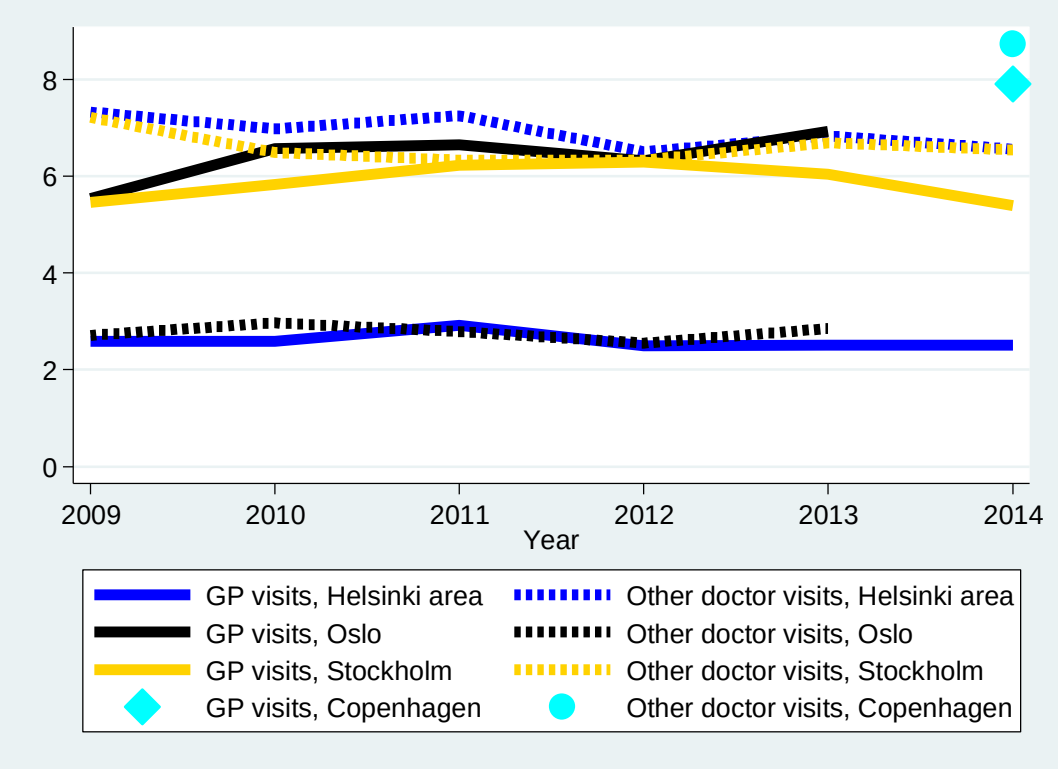

Figure 15. Risk-adjusted (model 1) number of visits to a doctor during one year after ischemic stroke.

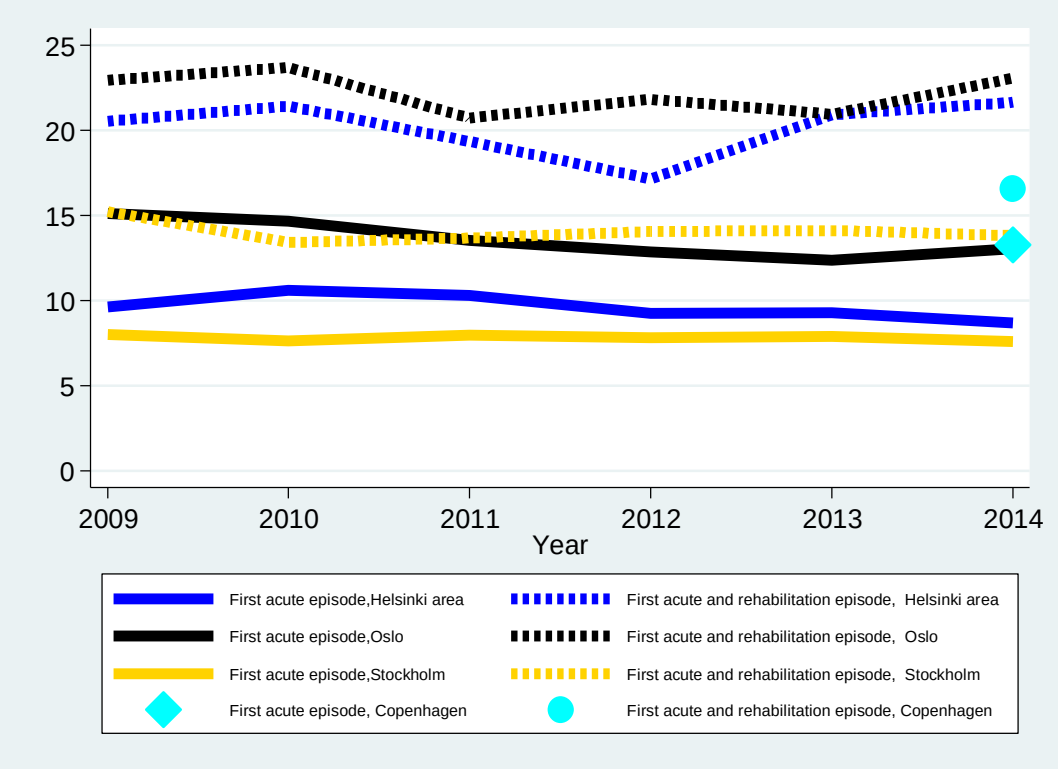

Figure 16. Risk-adjusted (model 1) length of stay during first acute hospital episode with and without rehabilitation, ischemic stroke patients.

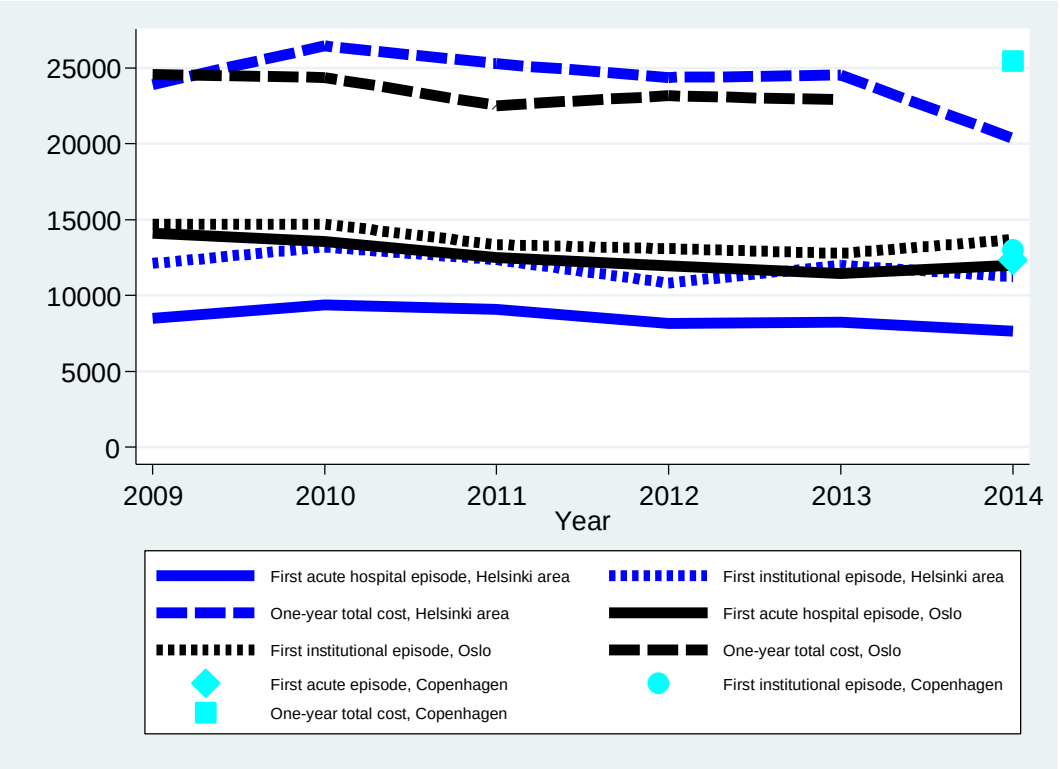

Figure 17. Risk-adjusted (model 2) cost during first hospital episode and one year, ischemic stroke patients.

7 Hip fracture

7.1 Patient structure

The number of operated hip fracture patients varied between the areas less than the number of AMI/ACS patients but more than the number of ischemic stroke patients. The age- and sex-standardised number of hip fracture patients per 10 000 people was in the Helsinki area 8.8 (varying over the years from 8.0 to 9.2), in Stockholm 12.5 (11.5–13.2), in Copenhagen 11.5 (2014) and in Oslo 14.1 (13.2–15.4). Again, the patients in Oslo and Stockholm were older compared to those in the Helsinki area and Copenhagen (Appendix Table 4). In the three areas where the data on all institutional care was available, 16–28% of the patients were in hospital or long-term care for all 90 days before the index day. We conducted a separate analysis using data where those institutionalised persons were excluded (Table 8 and Appendix Table 5). This exclusion was not applied in the original EuroHOPE cohort, but was similar to the one used in the Finnish PERFECT project aiming to make the patient cohort more homogenous (Sund et al. 2011). Since an important performance measure is how quickly patients are discharged home, it is reasonable to also consider only non-institutionalised patients before hip fracture.

7.2 Mortality

As expected, the development of mortality was somewhat lower among non-institutionalised patients compared to all patients in the three areas (Figure 18). In general, the risk-adjusted mortality figures were quite similar in the Helsinki area, Oslo and Stockholm among all hip fracture patients and there were no clear time trends in terms of 30-day and one-year mortalities (Figure 19). In Copenhagen, all risk-adjusted mortality figures were higher than in other areas, and in some measures the confidence intervals did not cut (Table 7).

The analysis restricted to non-institutionalised patients yielded roughly similar results, but now the risk-adjusted 30-day mortality figures were 2% lower in Oslo than in the Helsinki area (Table 8). Again, the 30-day figures were highest in Copenhagen, but the 90-day and one-year mortality differences between the three areas varied according to the risk-adjusted method being used: model 2 showed Copenhagen having approximately the same mortality rates as Helsinki and Oslo, whereas the other models showed higher mortality rates in Copenhagen. The time trend showed that the modestly increasing trend in 30-day mortality in Oslo from the year 2010 was paralleled by a decreasing trend in the Helsinki area. During the years 2013 and 2014, the figures were almost identical (Figure 20).

7.3 Discharge to home

Like stroke patients, we assessed the share of patients at home before and after the index day using a state diagram. Figure 21 describes the daily share of non-institutionalised hip fracture patients who were at home in one-year time intervals before and after the index day. Note that the share was quite similar between the areas. But the picture was again quite different when we considered the patients who were at home without home help services (Figure 22). The share of patients who were at home before hip fracture was again lowest in Copenhagen followed by Oslo, while highest in the Helsinki area, because the use of home help services was more frequent in the former two cities (Appendix Table 5). One week before the index day, 41% of patients in Copenhagen and 30% of patients in Oslo received home help services compared to a mere 16% in Helsinki.

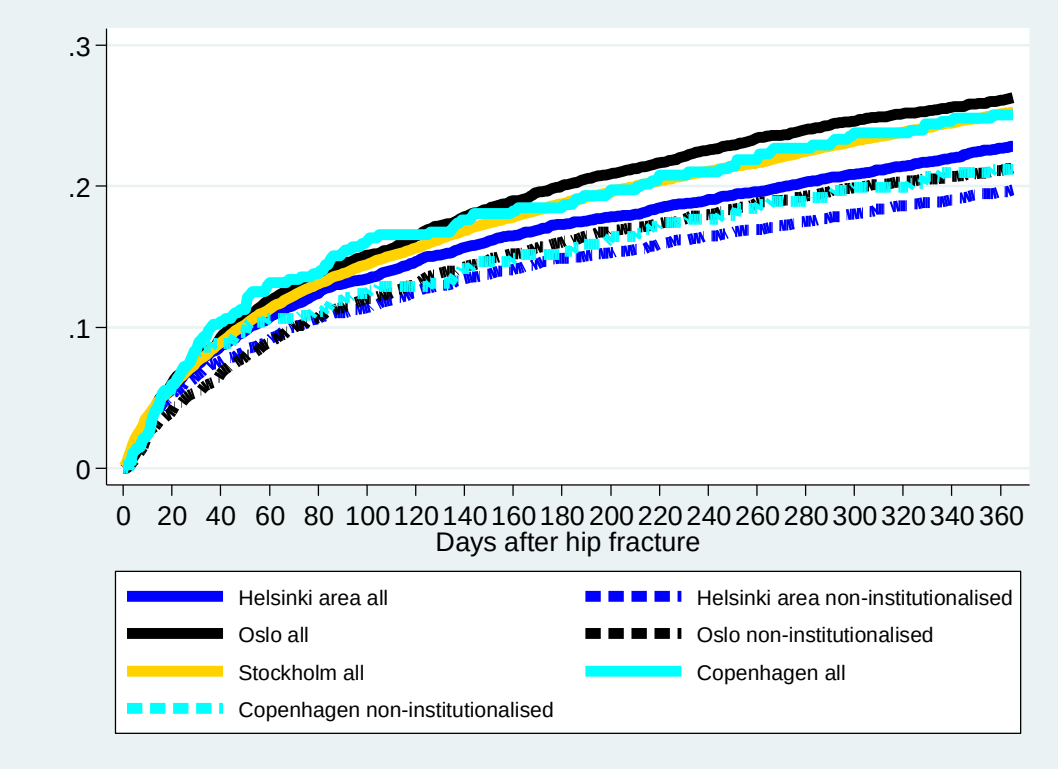

Figure 18. Daily share of patients who died after index day, hip fracture patients.

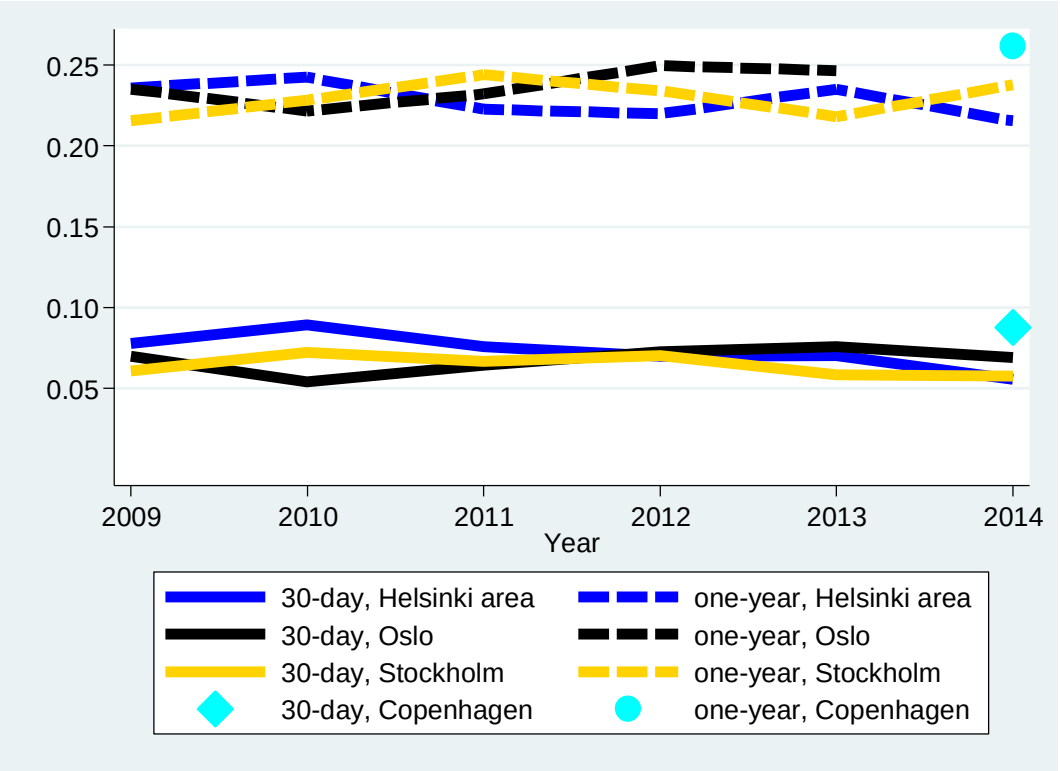

Figure 19. Risk-adjusted (model 1) 30-day and one-year mortality, all hip fracture patients.

Table 7. Risk adjusted performance indicators, hip fracture, all patients [#]

	Copenhagen 2014 (n=471)			Helsinki area 2009-2014 (n=4523)			Oslo 2009-2013/2014 (n=4093-4600)			Stockholm 2009/2011-2014 (n=8803-15328)		
	Value	min95	max95	Value	min95	max95	Value	min95	max95	Value	min95	max95
30 -day mortality												
Model 1	0.116	0.081	0.150	0.073	0.066	0.080	0.066	0.059	0.072	0.064	0.061	0.068
Model 2	0.100	0.070	0.129	0.073	0.066	0.080	0.059	0.053	0.065			
Model 3	0.127	0.090	0.165	0.073	0.066	0.080				0.065	0.060	0.070
Model 4	0.108	0.076	0.140	0.073	0.066	0.081						
90-day mortality												
Model 1	0.174	0.137	0.210	0.131	0.121	0.140	0.125	0.116	0.133	0.121	0.117	0.126
Model 2	0.149	0.118	0.179	0.131	0.121	0.140	0.111	0.104	0.119			
Model 3	0.201	0.160	0.243	0.131	0.121	0.140				0.122	0.115	0.128
Model 4	0.171	0.137	0.206	0.131	0.122	0.141						
One-year mortality												
Model 1	0.278	0.236	0.321	0.229	0.217	0.240	0.234	0.222	0.245	0.230	0.223	0.236
Model 2	0.239	0.204	0.274	0.229	0.217	0.240	0.212	0.202	0.222			
Model 3	0.311	0.265	0.357	0.229	0.217	0.240				0.233	0.225	0.241
Model 4	0.272	0.232	0.311	0.230	0.218	0.241						
Share of patients discharged to home (total)within 90 days												
Model 1	0.547	0.507	0.587	0.570	0.556	0.583	0.510	0.496	0.524			
Model 2	0.622	0.584	0.660	0.570	0.558	0.581	0.591	0.578	0.603			
Model 3	0.497	0.462	0.532	0.570	0.557	0.583						
Model 4	0.582	0.547	0.617	0.568	0.557	0.579						
Share of patients discharged home (without help) within 90 days												
Model 1	0.244	0.212	0.277	0.356	0.343	0.369	0.309	0.296	0.322			
Model 2	0.337	0.299	0.374	0.356	0.344	0.367	0.371	0.359	0.383			
Model 3	0.217	0.188	0.246	0.356	0.343	0.368						
Model 4	0.319	0.284	0.355	0.352	0.341	0.364						
Share of patients institutionalized (90 days)												
Model 1	0.238	0.199	0.277	0.263	0.250	0.275	0.321	0.309	0.334			
Model 2	0.201	0.171	0.231	0.263	0.252	0.274	0.258	0.249	0.266			
Model 3	0.284	0.239	0.329	0.263	0.251	0.275						
Model 4	0.211	0.180	0.242	0.264	0.253	0.275						
Share of patients institutionalized (one year)												
Model 1	0.116	0.088	0.144	0.163	0.152	0.173	0.219	0.207	0.231			
Model 2	0.101	0.078	0.123	0.163	0.154	0.172	0.166	0.158	0.173			
Model 3	0.143	0.109	0.177	0.163	0.152	0.173						
Model 4	0.106	0.082	0.129	0.164	0.154	0.173						
Length of first acute hospital episode												
Model 1	18.8	17.8	19.9	9.2	9.0	9.5	10.2	10.0	10.4	7.3	7.2	7.4
Model 2	17.7	16.8	18.7	9.2	9.0	9.5	10.3	10.1	10.6			
Model 3	18.8	17.8	19.8	9.2	9.0	9.5				7.8	7.7	7.9
Model 4	17.7	16.8	18.6	9.2	9.0	9.5						
Length of first acute hospital and rehabilitation episode												
Model 1	28.9	26.6	31.2	30.6	29.9	31.3	30.5	29.7	31.3	16.3	16.1	16.4
Model 2	26.2	24.2	28.2	30.6	29.9	31.3	29.8	29.0	30.6			
Model 3	29.1	26.8	31.4	30.6	29.9	31.3				16.5	16.3	16.7
Model 4	26.8	24.7	28.8	30.6	29.9	31.2						
Length of first institutional episode												
Model 1	44.0	41.0	46.9	44.6	43.7	45.5	47.6	46.7	48.5			
Model 2	39.8	37.4	42.2	44.3	43.5	45.1	42.4	41.7	43.1			
Model 3	47.5	44.3	50.6	44.4	43.5	45.3						
Model 4	41.1	38.6	43.5	44.2	43.4	45.0						
Number of days in acute hospital care, one year												
Model 1	21.8	20.2	23.4	11.4	11.1	11.8	11.6	11.3	11.8	11.3	11.1	11.5
Model 2	19.1	17.6	20.6	11.4	11.1	11.7	12.0	11.7	12.2			
Model 3	21.5	19.9	23.1	11.4	11.1	11.8				11.9	11.6	12.1
Model 4	18.8	17.3	20.3	11.4	11.1	11.7						
Number of inpatient days, one year												
Model 1	101.7	90.6	112.7	120.9	117.1	124.7	132.7	128.7	136.8			
Model 2	85.4	76.8	94.0	118.2	115.0	121.4	105.6	102.8	108.4			
Model 3	118.8	106.0	131.6	118.9	115.4	122.5						
Model 4	91.7	82.6	100.8	117.0	113.8	120.2						
Number of GP visits ,one year												
Model 1	8.2	7.6	8.9	1.9	1.8	2.0	3.0	2.8	3.2	3.0	2.9	3.1
Model 2	9.2	8.4	10.1	1.9	1.8	2.0	3.3	3.1	3.5			
Model 3	7.6	6.9	8.2	1.9	1.8	2.1				3.1	2.9	3.2
Model 4	8.7	7.9	9.5	1.9	1.8	2.0						
Number of other doctor visits,one year												
Model 1	7.1	6.4	7.8	5.3	4.9	5.6	0.7	0.7	0.8	4.7	4.6	4.9
Model 2	6.8	6.1	7.5	5.2	4.9	5.5	0.8	0.7	0.9			
Model 3	6.9	6.2	7.6	5.3	5.0	5.6				4.7	4.5	4.9
Model 4	6.8	6.2	7.5	5.3	5.0	5.6						
Number of home help visits, one year												
Model 1	111.7	84.5	138.8	75.1	69.8	80.3	107.6	100.7	114.5			
Model 2	73.5	56.6	90.5	75.1	70.3	79.9	91.0	85.3	96.8			
Model 3	115.2	87.3	143.2	75.1	69.9	80.3						
Model 4	73.0	56.2	89.8	75.1	70.3	79.9						
Cost of first acute hospital episode												
Model 1	14047	13579	14515	10029	9918	10139	10382	10266	10498	8783	8737	8830
Model 2	13590	13139	14040	10030	9922	10139	10438	10322	10554			
Model 3	14019	13554	14484	10029	9918	10139				9046	8983	9108
Model 4	13584	13134	14034	10030	9922	10139						
Cost of first acute and rehabilitatiin hospital episode												
Model 1	16450	15761	17138	14862	14676	15047	14969	14747	15190	10765	10707	10823
Model 2	15547	14923	16171	14861	14678	15044	14862	14649	15075			
Model 3	16499	15806	17192	14861	14678	15044				11094	11009	11180
Model 4	15684	15050	16319	14860	14678	15042						
Cost of first institutinal episode												
Model 1	19461	18714	20209	17695	17482	17908	18449	18235	18664			
Model 2	18238	17587	18888	17682	17486	17877	17488	17300	17676			
Model 3	20197	19423	20971	17686	17479	17892						
Model 4	18495	17833	19157	17678	17484	17872						
One- year cost												
Model 1	44920	41851	47988	42219	44025	42933	45973	44964	46982			
Model 2	37985	35571	40400	42938	42152	43723	39998	39226	40771			
Model 3	59024	53377	64670	42995	42131	43858						
Model 4	39132	36635	41628	42864	42086	43643						

[#] Risk adjustment variables includes also year indicators

Table 8. Risk adjusted performance indicators, hip fracture, non-institutionalised patients [#]

	Copenhagen 2014 (n=396)			Helsinki area 2009-2014 (n=3741)			Oslo 2009-2013/2014 (n=2929-3306)		
	Value	min95	max95	Value	min95	max95	Value	min95	max95
30 -day mortality									
Model 1	0.112	0.085	0.138	0.065	0.058	0.073	0.047	0.041	0.054
Model 2	0.088	0.067	0.108	0.065	0.058	0.073	0.043	0.037	0.049
Model 3	0.128	0.098	0.158	0.065	0.058	0.073			
Model 4	0.107	0.082	0.132	0.065	0.058	0.073			
90-day mortality									
Model 1	0.133	0.108	0.158	0.110	0.101	0.120	0.102	0.093	0.112
Model 2	0.104	0.085	0.122	0.110	0.101	0.120	0.096	0.087	0.104
Model 3	0.156	0.127	0.184	0.110	0.101	0.120			
Model 4	0.127	0.104	0.15	0.110	0.101	0.120			
One-year mortality									
Model 1	0.234	0.203	0.264	0.198	0.185	0.210	0.195	0.182	0.208
Model 2	0.191	0.167	0.215	0.198	0.185	0.210	0.186	0.174	0.198
Model 3	0.263	0.23	0.297	0.198	0.186	0.210			
Model 4	0.231	0.203	0.26	0.198	0.187	0.210			
Share of patients discharged home (total)within 90 days									
Model 1	0.641	0.611	0.670	0.679	0.665	0.694	0.681	0.665	0.696
Model 2	0.738	0.707	0.769	0.679	0.666	0.693	0.718	0.702	0.733
Model 3	0.604	0.577	0.631	0.679	0.666	0.693			
Model 4	0.687	0.659	0.716	0.678	0.665	0.691			
Share of patients discharged home (without help) within 90 days									
Model 1	0.277	0.252	0.303	0.422	0.407	0.437	0.409	0.393	0.425
Model 2	0.388	0.358	0.418	0.422	0.409	0.435	0.455	0.440	0.470
Model 3	0.252	0.229	0.276	0.422	0.408	0.436			
Model 4	0.368	0.339	0.396	0.419	0.405	0.432			
Share of patients institutionalised (90 days)									
Model 1	0.171	0.144	0.199	0.169	0.158	0.181	0.169	0.157	0.181
Model 2	0.116	0.098	0.135	0.169	0.158	0.181	0.145	0.135	0.155
Model 3	0.205	0.173	0.238	0.169	0.158	0.181			
Model 4	0.143	0.121	0.165	0.170	0.159	0.181			
Share of patients institutionalised (one year									
Model 1	0.065	0.048	0.083	0.082	0.073	0.091	0.086	0.076	0.096
Model 2	0.042	0.031	0.053	0.082	0.074	0.090	0.072	0.064	0.080
Model 3	0.082	0.06	0.104	0.082	0.074	0.091			
Model 4	0.054	0.041	0.068	0.082	0.074	0.091			
Length of first acute hospital episode									
Model 1	19.3	18.5	20.0	9.3	9.1	9.6	11.5	11.2	11.7
Model 2	18.6	17.9	19.3	9.3	9.1	9.6	12.2	11.9	12.5
Model 3	19.3	18.5	20.0	9.3	9.1	9.6			
Model 4	18.6	18.0	19.3	9.3	9.1	9.6			
Length of first acute hospital and rehabiltation episode									
Model 1	31.4	29.6	33.2	31.4	30.7	32.2	33.7	32.8	34.5
Model 2	28.8	27.2	30.4	31.4	30.6	32.1	32.6	31.8	33.4
Model 3	32.2	30.4	34.1	31.4	30.6	32.1			
Model 4	29.5	27.8	31.1	31.4	30.6	32.1			
Length of first institutional episode									
Model 1	39.0	36.8	41.1	38.6	37.7	39.5	38.0	37.0	38.9
Model 2	33.9	32.1	35.7	38.4	37.6	39.3	35.7	34.8	36.6
Model 3	41.4	39.0	43.7	38.5	37.6	39.3			
Model 4	35.6	33.7	37.6	38.4	37.5	39.2			
Number of days in acute hospital care, one year									
Model 1	22.5	21.2	23.8	11.7	11.4	12.0	12.9	12.6	13.3
Model 2	20.3	19.2	21.5	11.7	11.3	12.0	13.0	12.6	13.3
Model 3	22.3	21.1	23.5	11.7	11.4	12.0			
Model 4	20.0	18.9	21.1	11.7	11.3	12.0			
Number of inpatient days, one year									
Model 1	85.3	77.6	93.0	93.0	89.5	96.5	88.8	85.0	92.7
Model 2	64.8	59.2	70.5	91.2	88.0	94.4	76.9	73.8	80.1
Model 3	98.4	89.3	107.6	91.5	88.2	94.9			
Model 4	72.2	65.9	78.5	90.3	87.1	93.5			
Number of GP visits ,one year									
Model 1	7.9	7.4	8.4	2.1	1.9	2.2	4.1	3.9	4.4
Model 2	9.0	8.3	9.6	2.1	1.9	2.2	4.5	4.2	4.7
Model 3	7.6	7.1	8.1	2.1	1.9	2.2			
Model 4	8.7	8.1	9.3	2.1	1.9	2.2			
Number of other doctor visits,one year									
Model 1	7.9	7.4	8.5	5.7	5.3	6.0	1.0	0.9	1.1
Model 2	7.9	7.4	8.5	5.6	5.3	6.0	1.0	1.0	1.1
Model 3	7.9	7.3	8.5	5.7	5.3	6.1	1.1		
Model 4	7.7	7.1	8.3	5.7	5.3	6.0			
Number of home help visits, one year									
Model 1	137.6	114.3	160.8	88.6	82.5	94.7	123.6	115.3	131.9
Model 2	90.4	75.7	105.1	88.6	82.8	94.3	91.9	86.0	97.8
Model 3	152.6	126.8	178.4	88.6	82.5	94.7			
Model 4	89.8	75.3	104.4	88.6	82.9	94.3			
Cost of first acute hospital episode*									
Model 1	14207	13861	14553	10073	9949	10197	10998	10858	11138
Model 2	13072	13965	13630	10073	9949	10196	11004	10864	11144
Model 3	12994	12680	13307	10073	9949	10196			
Model 4	13983	13651	14316	10073	9949	10196			
Cost of first acute and rehabilitatiin hospital episode									
Model 1	17084	16553	17615	15071	14868	15274	16032	15794	16271
Model 2	16311	15816	16806	15069	14867	15270	15811	15580	16042
Model 3	17284	16744	17824	15069	14867	15271			
Model 4	16482	15979	16986	15068	14867	15269			
Cost of first institutional episode									
Model 1	18625	18052	19197	16526	16304	16748	16902	16653	17150
Model 2	17289	16780	17799	16519	16305	16732	16439	16207	16671
Model 3	19180	18584	19776	16520	16303	16736			
Model 4	17701	17175	18227	16516	16305	16728			
One-year cost									
Model 1	43084	40773	45395	37807	36921	38693	37136	36120	38152
Model 2	34777	33031	36523	37629	36827	38431	33154	32324	33984
Model 3	46802	44217	49388	37678	36826	38530			
Model 4	36415	34559	38270	37555	36761	38349			

[#] Risk adjustment variables includes also year indicators

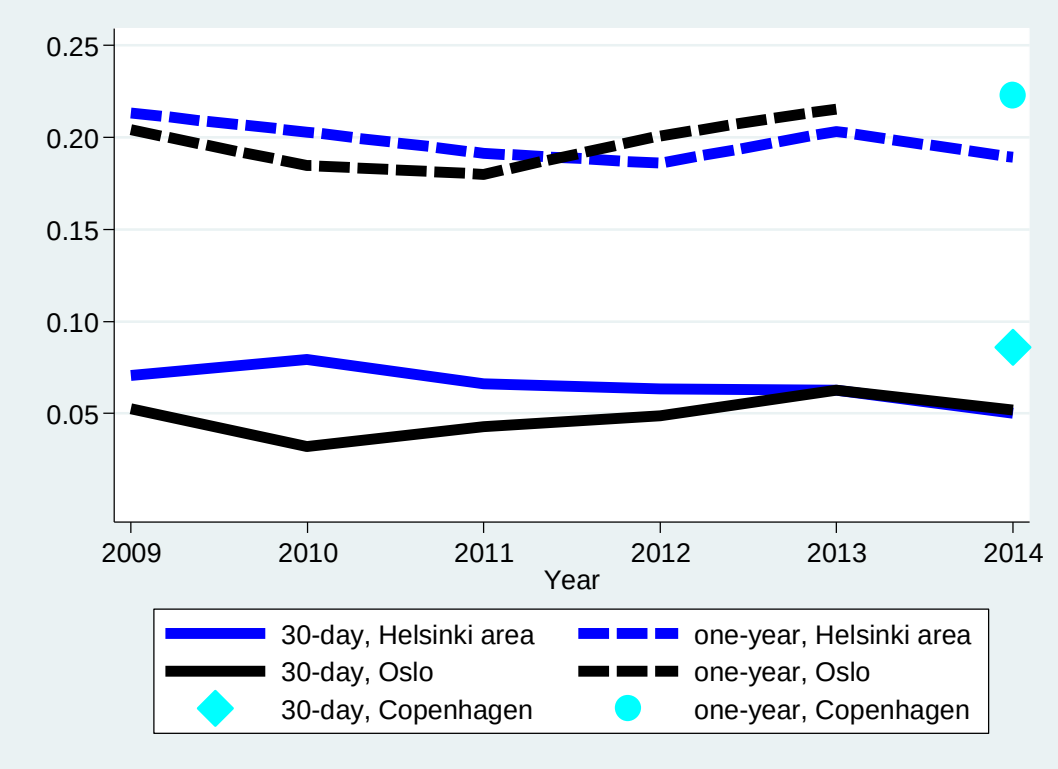

Figure 20. Risk-adjusted (model 1) 30-day and one-year mortality, non-institutionalised hip fracture patients.

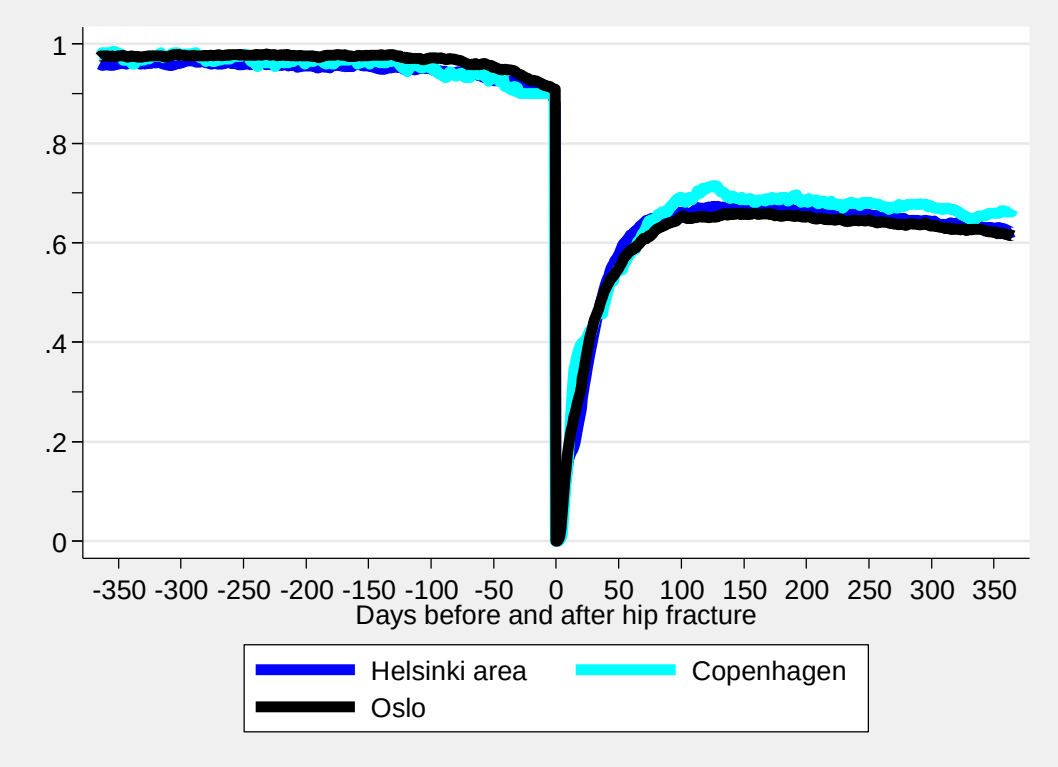

Figure 21. Share of patients at home before and after hip fracture, non-institutionalised patients.

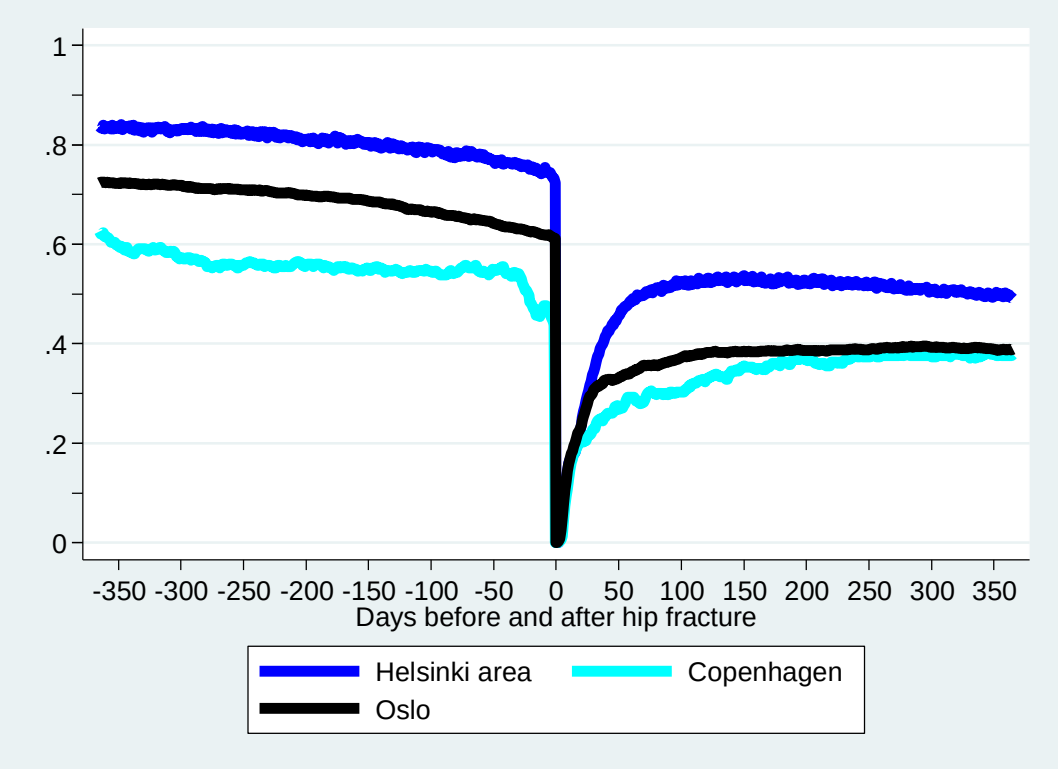

Figure 22. Share of patients at home without help before and after hip fracture, non-institutionalised patients.

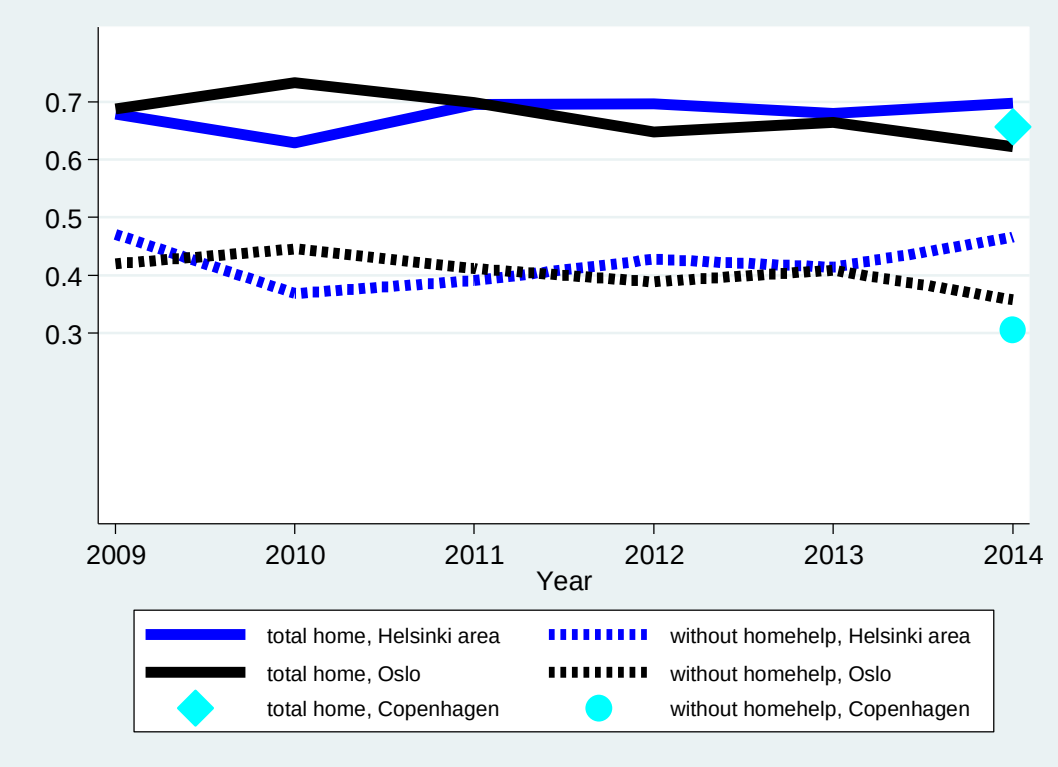

Figure 23. Risk-adjusted (model 1) share of patients discharged to home with and without home help within 90 days, non-institutionalised hip fracture patients.

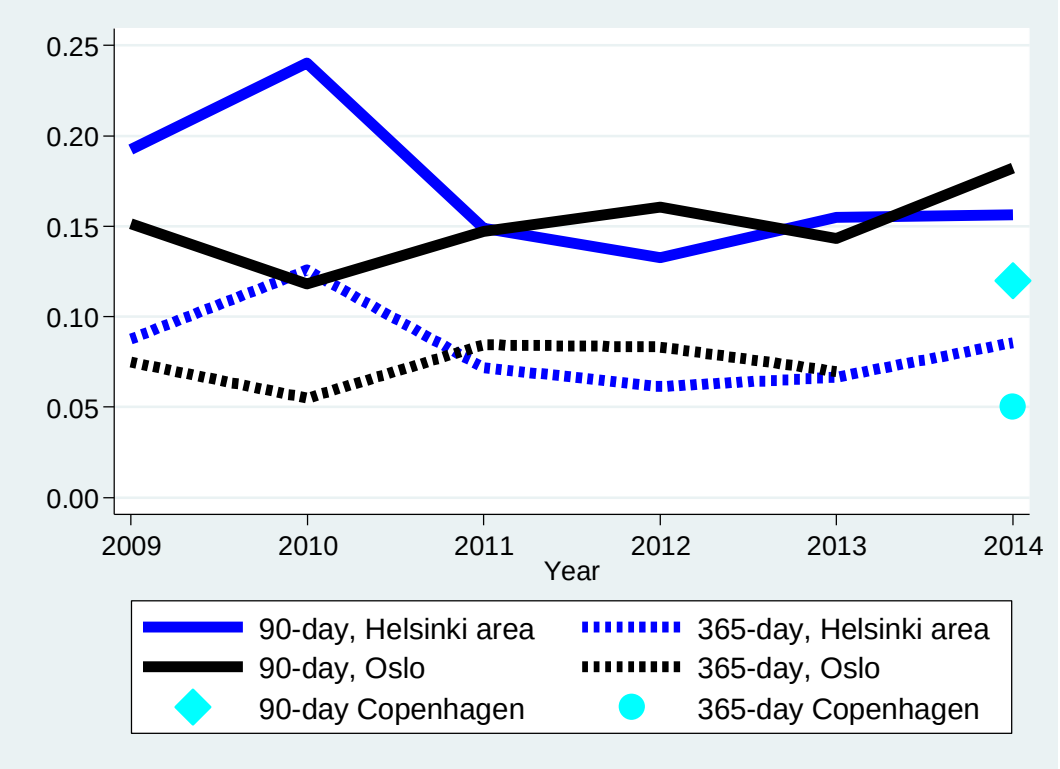

Figure 24. Risk-adjusted (model 2) share of institutionalised patients after 90 days and one year, non-institutionalised (before fracture) patients.

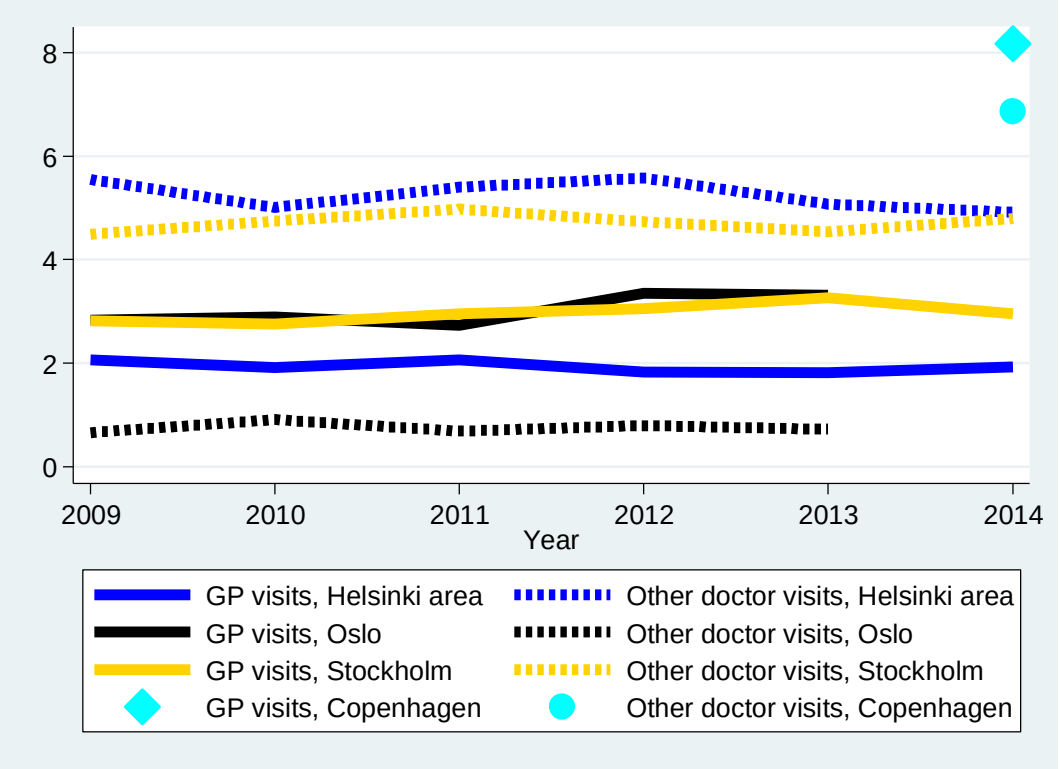

Figure 25. Risk-adjusted (Model 1) number of visits to a doctor (one year), all hip fracture patients.

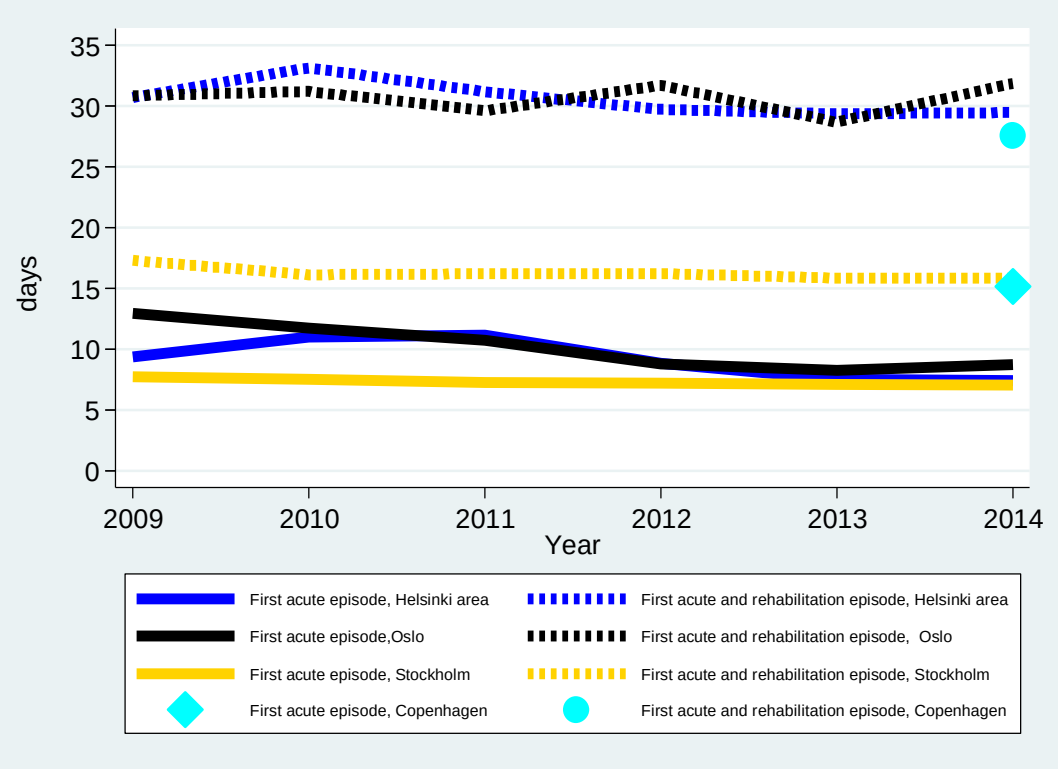

Figure 26. Risk-adjusted (model 1) length of stay during first acute hospital episode with and without rehabilitation, all hip fracture patients

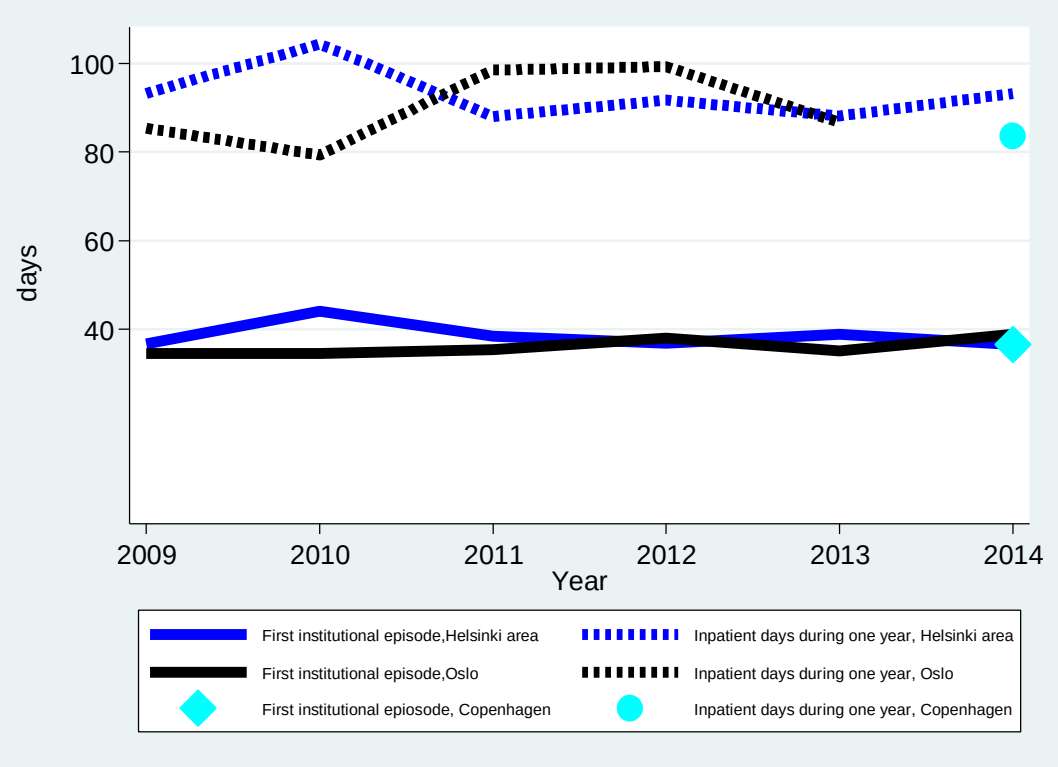

Figure 27. Risk-adjusted (model 1) length of stay during the first institutional episode and total one-year number of inpatient days, non-institutionalised hip fracture patients.

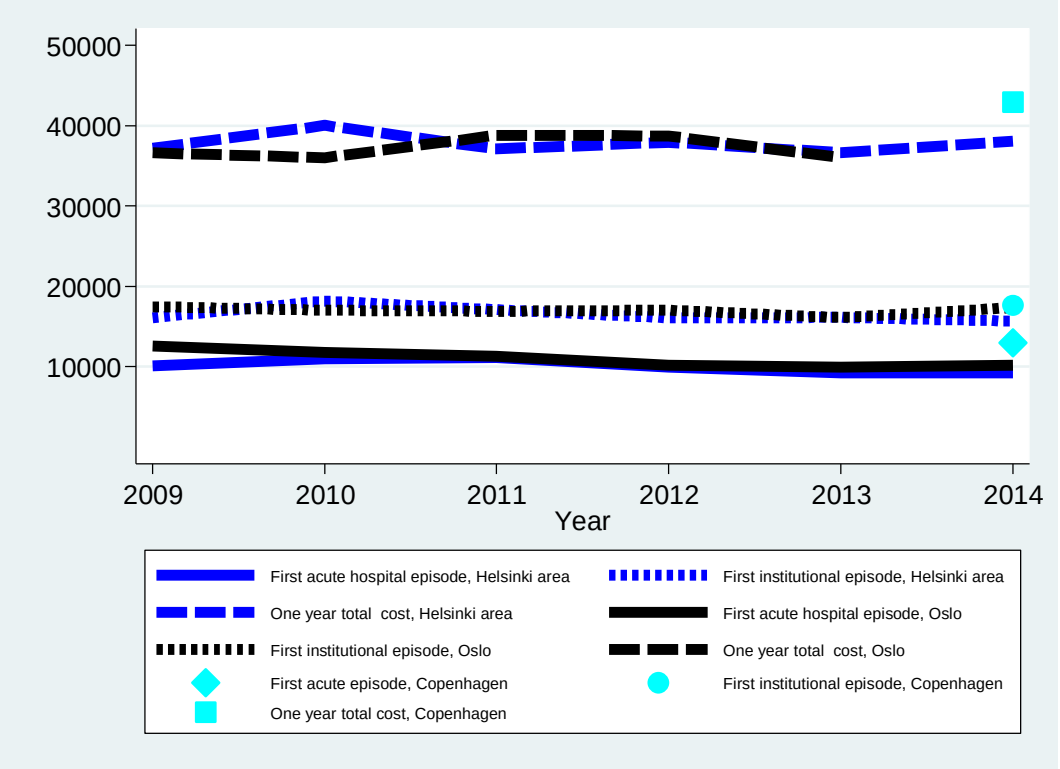

Figure 28. Risk-adjusted (Model 1) cost during first hospital episode and after one year, non-institutionalised hip fracture patients.

Even among the non-institutionalised patients, the two risk-adjusted methods gave different results in terms of the share of patients discharged to home when comparing Copenhagen to the Helsinki area and Oslo (Table 7). When model 1 was used for risk-adjustment, the shares were about the same in the three areas for total discharges, but clearly lowest in Copenhagen for discharges without home help. When model 2 was used for risk-adjustment, the shares were about 3-4 percentage points higher in Oslo compared to Helsinki. According to the most comprehensive risk-adjustment (model 4), the shares of total discharges were the same in the Helsinki area and Copenhagen, but discharges without home help in Helsinki were 5 percentage points higher. The risk-adjusted shares have increased in the Helsinki area, whereas in Oslo they have even somewhat decreased (Figure 23).

7.4 Institutionalisation

After hip fracture, the share of non-pre-institutionalised patients who were still in institutional care after 90 days was 14.4% in Copenhagen, 16.9% in the Helsinki area and 18% in Oslo (Appendix Table 5). The corresponding figures after one year were 6.6% in Copenhagen, 8.2% in the Helsinki area and 9.2% in Oslo. Again, the comparison between Helsinki, Oslo and Copenhagen varied according to the risk - adjustment: for 90- day institutionalisation, model 1 gave approximately the same shares for the three areas, whereas model 2 gave a rate more than 2 percentage points higher for the Helsinki area compared to Oslo and approximately 5 percentage points higher for Copenhagen (Table 8). The difference between Helsinki and Oslo was due to figures from earlier years of the study period; during the years 2009–2010, both shares were clearly higher in the Helsinki area, but afterwards the shares decreased in Helsinki and increased in Oslo such that they reached the same level in both areas after 2011 (Figure 24). In Copenhagen, the shares of institutionalised patients were lower compared to Helsinki when model 2 and 4 were used for risk-adjustment.

7.5 Use and cost of services

The pattern of doctor visits was similar to the care of stroke patients. In Copenhagen, the number of GP visits (all hip fracture patients) during one year (8.2) was almost three times greater than in Oslo and Stockholm (2.9) and more than four times greater than in the Helsinki area (1.9). The other type of doctor visits were used more often in Copenhagen (7.1), the Helsinki area (5.3) and Stockholm (4.5) compared to Oslo (0.7) (Appendix Table 5). The risk- adjustment did not affect the comparisons, and likewise the analysis of non-institutionalised patients gave similar results between the three areas. The differences between the areas were rather stable during the study period (Figure 25).

As among stroke patients, the LOS of inpatient care given during first acute episode for all hip fracture patients was shortest in Stockholm, even when rehabilitation was included. The LOS during the first hospital acute episode was longest in Copenhagen. Both in Oslo and the Helsinki area, the LOS for acute care decreased during the study period (Figure 26). When rehabilitation admissions were taken into account, the length of stay somewhat decreased in the Helsinki area and increased in Oslo (Figure 26).

Among the non-institutionalised hip fracture patients, the LOS during the first institutional episode as well as the total number of inpatient days during first year were about the same in Copenhagen, the Helsinki area and Oslo when model 1 was used for risk-adjustment (Table 8). But the time trends in one-year inpatient days were different between Oslo and Helsinki (Figure 27). Using model 2 for risk-adjustment yielded somewhat shorter figures for both measures in Copenhagen and Oslo compared to Helsinki (Table 8)

The adjusted (model 1) cost of the first institutional hospital episode remained at the same level in Helsinki and Oslo during the whole study period, which was somewhat lower than in Copenhagen in 2014 (Figure 28). As a result of greater use of institutional care, the total one-year costs were somewhat higher in the Helsinki are compared with Oslo during the years 2009–2010. Subsequently, though, the costs were about the same in both areas. Also, these figures proved sensitive to the risk-adjustment model used. When model 2 was used instead of model 1, the one-year costs were about 4500 € higher in Helsinki and 1600 € higher in Copenhagen compared to Oslo.

8 Concluding remarks

As health care systems may have a different role for primary, secondary, tertiary and social care services in different countries, the impact these sectors have on patient outcomes will also vary. To the best of our knowledge, this was the first international comparison where register data from primary and long-term care services were linked with hospital discharge data and mortality registers.

The study shows that for patients with mixed care pathways across primary, secondary, tertiary and social services, a performance comparison with data only from secondary care is not always sufficient for international comparisons. Our approach gave us an opportunity to evaluate outcome measures other than mere survival, such as measures describing the increase in quick discharges to home (with and without help) and the reduction in institutionalisation, which have been an important policy aim in all the Nordic countries. Such measures can be used for proxy variables of outcomes if we can assume that the measures to some extent reflect the functional status of patients.

The main methodological conclusions of the study are as follows:

- The approach studied and presented here is an important extension in the field of health system performance analysis. With individual-level, routinely collected data, it is possible to considerably deepen the analysis and enrich the set of outcome and process indicators available for system performance comparison.
- Using administrative data for international comparisons makes it challenging to obtain comparative information on the incidence of acute diseases because of national differences in definitions and coverage of hospital discharge registers.
- Performance analysis requires adequate risk-adjustment to reduce the bias associated with patient selection. However, the ranking of areas was sensitive to the risk-adjustment method used. In particular, the previous use of different services (inpatient care, home help) as covariates in the adjusted models changed the rankings between the areas in terms of the measures describing the use of inpatient care and costs during a longer follow-up period. By including them, we assumed that the previous use of services was closely related to the functional ability of patients. However, we cannot confirm that the functional status of persons living at home with or without help is the same between the regions, because it may to some extent reflect differences in policy priorities. On the other hand, the inclusion of these measures in risk-adjustments can be justified if they reflect changes in the use of services because of the onset of a disease, and these changes can be affected by treatments or interventions.
- Risk- adjustment based on age, sex and even comorbidities based on medical history of patients may not be enough for a reliable performance comparison of diseases affecting older persons. Our study indicates that functional ability (such as measures of activities in daily living) before the onset of disease is an important predictor of performance and should be taken into account in risk-adjustment.
- In this pilot study, it was not possible to pool data from different countries, and risk-adjustment was done using coefficients calculated from the Helsinki area. In addition, the coverage and years of availability of the data varied between areas. An analysis will be made more reliable and carried out more easily if the data can be pooled and if other information, such as socioeconomic variables, can be included, enabling possibilities to, e.g. evaluate the effect of a reform made in one area using other areas as control groups (e.g. Häkkinen et al. 2018).
- One special challenge is to increase the comparability of register data describing non institutional services. For example, home help was not measured using the same units (visits in the Helsinki area and hours in Oslo and Copenhagen). Our estimates were based on the assumption that one hour equals two visits.
- Our approach to measuring cost by means of resource use has both strengths and weaknesses. The main advantage is that we can avoid concerns about differences in cost-accounting systems and

prices between the countries and producers. It is also an easy way to combine different services. The main weakness of this approach is that it does not take into account the differences in the unit prices of resource items across countries. For example, the cost of inpatient days or procedures or visits may vary owing to differences in inputs (personnel, working time, etc.) and we assume that the relative costs of these cost items are the same in both countries. Thus, we compared resource use using Finnish estimates on the average unit cost of services, not actual spending, and our cost measure does not necessarily reflect actual expenditure differences.

In spite of the shortcomings, our results indicate some differences between the capital areas, reflecting important policy issues:

- The considerable differences in age- and sex-standardised incidence figures as well as in the age structure of patients in the disease groups may reflect differences in the role of acute care in treating patterns as well as a more aggressive and resource-intensive treatment in Norway and Sweden. In Oslo, for example, the age structure of the total population is much younger compared to Helsinki and Copenhagen, but the age structure of the patients was much older in Oslo. In Oslo, the age- and sex-standardised number of patients per population was also highest in all four disease groups. In addition, the share of patients who were permanently institutionalised before the onset of their disease was much higher in Oslo than in the Helsinki area. In the Helsinki area, e.g. AMI and stroke patients included only patients admitted to Helsinki University Hospital, which has a more developed capacity (e.g. possibility to perform PCI or intensive stroke treatments) not available in other hospitals (e.g. health centres).
- The treatment of the diseases was most concentrated on acute hospital care in Copenhagen, where the length of the first acute hospital stay was longest (among ACS and hip fracture patients) and the one-year use of both inpatient and outpatient acute hospital care services (all patients groups) were highest. This could relate to national differences in hospital organisation.
- In Oslo, the ambulatory services compromised mainly services from GPs, while in Copenhagen and Stockholm ambulatory services included both GPs and hospital outpatient services and in the Helsinki area merely hospital outpatient services. In addition, the use of home help services both before and after the onset of disease was considerable higher in Copenhagen and Oslo compared to the Helsinki area. This may indicate more developed primary and home help services in Norway and Denmark compared to Finland and to some extent Stockholm, as assumed based on descriptive information on the primary care systems (Häkkinen and Jonsson, 2009). However, these differences were not associated with better outcomes in Copenhagen and Oslo compared to Helsinki area.
- Although the mortality figures were sensitive to risk- adjustment, the results indicate higher mortality rates in Stockholm among AMI/ACS patients and stroke patients (30-day mortality) and in Copenhagen among hip fracture patients.

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APPENDICES

Appendix 1: Costing of services

Service	Method	Value in 2014
Acute hospital care	Based on cost function estimated using individual level cost data (2014 prices) from Helsinki University hospital	**AMI/ACS** First acute hospital episode: AMI: Cost €= 6705*CABG +PCI*2073+968*LOS - 707 ACS: Cost €=8440*CABG +PCI*2100+ 959*LOS - 757 where LOS= length of stay; CABG=1 if coronary artery bypass surgery performed ; PCI =1 if percutaneous coronary intervention performed One year cost of acute care: AMI: cost €= 5400 *CABG365 + 1729*PCI365 + 993*LOS365_A+917* LOS365_O -813 ACS: cost €= 6132 *CABG365 + 1851* pci365 + 963*LOS365_A +876* LOS365_O -783 where CABG365=number coronary artery bypass surgery performed during 365 days; PCI365 =number percutaneous coronary interventions performed during the 365 days; LOS365_A=number of days in acute care during 365 days because of AMI/ACS; LOS365_O numbers days in acute care during 365 days because on non AMI/ACS diagnoses **STROKE** 882 €/ acute care day **Hip fracture** First acute hospital episode Cost €= 1810 *group1 - 1221*S720 + 510*LOS+ 5119 where group1=1, if operation is partial prosthesis ,=0 if other operation; S720= 1, if main diagnosis is ICD:10: S72,0 , 0=if ICD:10 S72.1 or S72,2 ; LOS=length of stay One year cost of acute care Cost € = 5894*PROC365 + 284*LOS365_H +7 09*LOS_O + 1678.326 where PROC = Number of hip fracture operations performed during 365 days; LOS365_H=number of days in acute care during 365 days because of hip fracture; LOS365_O numbers days in acute care during 365 days because on non hip fracture diagnoses
Rehabilitation and non specialized short term inpatient care. In Helsinki area includes short term care (length of stay less than 90 days in health centres) and care in psychiatric departments	Standard cost estimates 2011 (Kapiainen et al.,2014)	226,2 € /day
Long term stay in municipal institution	Standard cost estimates 2011 (Kapiainen et al.,2014)	202,8 €/day
Outpatient visits of hospital including day surgery	Standard cost estimates 2011 (Kapiainen et al.,2014)	349.2 €/visit
Visits to a specialist. In Helsinki area visits to a private specialist	Based on cost function estimates using Finnish individual level cost data (current prices)	286.6€/visit
Visit to a doctor primary care including home visits . In Helsinki area visits to health centre doctor and private non specialist doctor	Based on cost function estimates using Finnish individual level cost data (current prices)	116, 8 €/visit
Home care . In Oslo and Copenhagen and assumed 2 visit per hour	Standard cost estimates 2011 (Kapiainen et al.,2014)	52,0€ /visit

Appendix Table 1. Descriptive statistics AMI

		Copenhagen 2014 (n=622)		Helsinki area 2009-2014 (n=3604)		Oslo 2009-2013/2014 (n=5491-6209)		Stockhom 2009/2011-2014 (n=9978-17776)	
		mean	sd	mean	sd	mean	sd	mean	sd
AGE*	**mean**	65.551	14.194	67.7	12.9	72.3	14.9	72.0	13.5
	age under 50	0.133	0.340	0.090	0.286	0.1	0.3	0.058	0.234
	age 50-54	0.084	0.277	0.079	0.269	0.064	0.244	0.057	0.232
	age 55-59	0.133	0.340	0.102	0.303	0.083	0.276	0.077	0.266
	age 60-64$	0.130	0.337	0.138	0.345	0.095	0.293	0.104	0.306
	age 65-69	0.133	0.340	0.133	0.340	0.103	0.304	0.130	0.336
	age 70-74	0.103	0.304	0.125	0.331	0.093	0.290	0.114	0.318
	age 75- 79	0.103	0.304	0.122	0.328	0.102	0.302	0.118	0.323
	age 80-84	0.080	0.272	0.115	0.319	0.125	0.331	0.129	0.335
	age 85-89	0.055	0.228	0.067	0.251	0.139	0.346	0.124	0.330
	age over 89	0.045	0.208	0.030	0.170	0.122	0.327	0.088	0.284
Gender*	**Male**	0.662	0.473	0.666	0.472	0.598	0.490	0.630	0.483
Type of AMI*	**Stemi**	0.277	0.448	0.466	0.499	0.382	0.486	0.244	0.429
	Non stemi	0.436	0.496	0.469	0.499	0.338	0.473	0.450	0.497
	Undefined	0.288	0.453	0.064	0.245	0.279	0.449	0.307	0.461
Cohort year *	**2009**			0.152		0.191		0.178	
	2010			0.150		0.185		0.174	
	2011			0.155		0.173		0.171	
	2012			0.170		0.169		0.167	
	2013			0.201		0.158		0.154	
	2014	1.000		0.172		0.123		0.156	
Number of days in different care arrangements within 90 days before index admission*	**Acute hospital days**	3.1	5.4	1.0	4.5	0.6	3.1	2.089	
	Other inpatient days	2.1	13.1	2.6	12.2	9.2	26.0		
	Days at home with home help	10.8	27.5	2.1	10.6	14.3	31.5		
	Days at home without home help	74.0	31.0	84.4	17.4	65.9	39.0		
Share of patients who were the hospital or long-term care for all 90 days before the index admission*		0.023	0.148	0.016	0.009	0.088	0.283		
Comorbidities based on pervious year use of hospital care and prescribed medicines * **	**Hypertension**	0.593	0.492	0.625	0.484			0.682	0.466
	Coronary artery disease	0.085	0.279	0.060	0.238			0.104	0.305
	Atrial fibrillation	0.034	0.181	0.022	0.146			0.064	0.244
	Cardiac insufficiency (heart failure)	0.045	0.208	0.024	0.154			0.068	0.252
	Diabetes mellitus	0.183	0.387	0.210	0.407			0.207	0.405
	Cancer	0.011	0.106	0.026	0.159			0.033	0.179
	COPD and asthma	0.164	0.371	0.153	0.360			0.163	0.370
	Depression	0.127	0.333	0.109	0.311			0.143	0.350
	Parkinson's disease	0.013	0.113	0.015	0.123			0.017	0.128
	Mental disorders	0.050	0.218	0.025	0.157			0.024	0.152
	Stroke	0.023	0.148	0.014	0.119			0.022	0.147
Performance indicators									
30 -day mortality*		0.042	0.200	0.068	0.252	0.099	0.298	0.096	0.295
90-day mortality*		0.053	0.224	0.083	0.276	0.132	0.338	0.127	0.333
One-year mortality**		0.092	0.289	0.122	0.327	0.215	0.411	0.192	0.394
Share of patients discharged home (total)within 90 days*		0.899	0.302	0.877	0.328	0.769	0.421		
Share of patients discharged home (without help) within 90 days*		0.752	0.432	0.777	0.416	0.625	0.484		
Share of patients institutionalized (90 days)*		0.031	0.172	0.021	0.143	0.082	0.275		
Share of patients institutionalized (one year)**		0.016	0.126	0.010	0.101	0.056	0.230		
Length of first acute hospital episode*		8.4	9.1	8.4	8.2	6.9	5.6	6.4	5.8
Length of first acute hospital and rehabiltation episode*		9.1	11.2	10.6	12.6	12.0	18.6	8.0	8.4
Length of first institutional episode*		11.2	17.1	11.8	15.9	15.5	24.5		
Number of days in acute hospital care, one year**		12.6	14.7	11.8	13.9	9.7	9.8		
Number of days in acute hospital care and inpatient rehabilitation , one year**		14.7	19.4	17.3	24.7	25.6	56.7	15.1	19.4
Number of inpatient days, one year**		24.2	57.1	23.7	50.5	45.3	94.9		
Number of GP visits ,one year**		6.2	6.6	2.6	3.1	7.8	9.2	4.5	6.7
Number of other doctor visits, one year*		13.3	14.9	6.7	13.7	1.3	3.5	6.6	11.5
Number home help visits, one year**		39.4	160.1	21.0	89.8	61.7	179.4		
Cost of first acute hospital episode*		8609	9140	9859	8932	7030	5881	6692	6098
Cost of first acute and rehabilitation hospital episode*		8744	9423	10352	9401	8137	7485	7061	6404
Cost of first institutional episode*		9107	9805	10592	9628	8853	8088		
One year cost**		24112	24209	19568	21186	21662	26571		

*Oslo: excluded patients with after mid September in in 2014 (n=6269)

**Oslo: excluded patients with index day in 2014 (n=5491)

*** Stockholm: exluded patients with indexday before the first of July 2011 (n= 9978)

Appendix Table 2. Descriptive statistics ACS

		Copenhagen 2014 (n=741)		Helsinki area 2009-2014 (n=4127)		Oslo 2009-2013/2014 (n=6548-7457)		Stockholm 2009/2011-2014 (n=11513-20366)	
		mean	sd	mean	sd	mean	sd	mean	sd
AGE*	**mean**	65.0	13.7	67.7	12.8	71.3	14.8	71.4	13.2
	age under 50	0.131	0.338	0.086	0.280	0.079	0.270	0.057	0.231
	age 50-54	0.089	0.285	0.078	0.267	0.069	0.254	0.060	0.238
	age 55-59	0.128	0.335	0.101	0.302	0.090	0.286	0.082	0.275
	age 60-64$	0.146	0.353	0.140	0.348	0.103	0.304	0.110	0.313
	age 65-69	0.146	0.353	0.132	0.338	0.109	0.311	0.136	0.343
	age 70-74	0.105	0.307	0.130	0.337	0.095	0.293	0.121	0.326
	age 75- 79	0.093	0.291	0.126	0.332	0.100	0.300	0.119	0.324
	age 80-84	0.076	0.264	0.113	0.316	0.118	0.323	0.123	0.329
	age 85-89	0.049	0.215	0.065	0.247	0.129	0.336	0.114	0.317
	age over 89	0.038	0.191	0.028	0.166	0.107	0.309	0.079	0.269
Gender*	**Male**	0.660	0.474	0.660	0.474	0.605	0.489	0.644	0.479
Type of AMI*	**Stemi**	0.208	0.406	0.406	0.491	0.319	0.466	0.212	0.409
	Non stemi	0.278	0.448	0.408	0.491	0.274	0.446	0.389	0.488
	Undefined	0.212	0.409	0.056	0.231	0.232	0.422	0.266	0.442
	Unstable Angina	0.302	0.460	0.130	0.336	0.175	0.380	0.133	0.339
Cohort year *	**2009**			0.155		0.191		0.171	
	2010			0.151		0.186		0.170	
	2011			0.153		0.170		0.168	
	2012			0.172		0.171		0.155	
	2013			0.199		0.160		0.158	
	2014	1.000		0.170		0.122			
Number of days in different care arrangements within 90 days before index admission*	**Acute hospital days**	3.13	5.24	0.94	4.68	0.54	3.00	2.01	3.57
	Other inpatient days	2.2	13.5	2.5	11.8	8.2	24.7		
	Days at home with home help	10.4	27.1	2.0	10.3	13.2	30.6		
	Days at home without home help	74.2	30.6	84.6	16.9	68.1	37.8		
Share of patients in institution 90 days before ACS*		0.024	0.154	0.016	0.124	0.078	0.268		
Comorbidities based on pervious year use of hospital care and prescribed medicines* **	**Hypertension**	0.613	0.487	0.640	0.480			0.692	0.462
	Coronary artery disease	0.101	0.302	0.064	0.246			0.107	0.309
	Atrial fibrillation	0.035	0.184	0.021	0.144			0.061	0.239
	Cardiac insufficiency (heart failure)	0.043	0.203	0.024	0.153			0.063	0.243
	Diabetes mellitus	0.201	0.401	0.215	0.411			0.210	0.407
	Cancer	0.011	0.103	0.024	0.154			0.032	0.177
	COPD and asthma	0.173	0.378	0.155	0.361			0.162	0.369
	Depression	0.131	0.338	0.110	0.313			0.140	0.347
	Parkinson's disease	0.011	0.103	0.015	0.121			0.017	0.129
	Mental disorders	0.061	0.239	0.024	0.154			0.022	0.147
	Stroke	0.019	0.136	0.015	0.123			0.021	0.144
Performance indicators									
30 -day mortality*		0.035	0.184	0.062	0.241	0.083	0.276	0.084	0.278
90-day mortality*		0.046	0.209	0.077	0.266	0.113	0.317	0.111	0.315
One-year mortality**		0.084	0.277	0.113	0.317	0.186	0.389	0.171	0.377
Share of patients discharged home (total)within 90 days*		0.907	0.291	0.885	0.319	0.798	0.402		
Share of patients discharged home (without help) within 90 days*		0.760	0.428	0.791	0.406	0.663	0.473		
Share of patients institutionalized (90 days)*		0.031	0.174	0.020	0.141	0.073	0.261		
Share of patients institutionalized (one year)**		0.019	0.136	0.010	0.098	0.051	0.219		
Length of first acute hospital episode*		9.0	8.8	8.2	8.3	6.5	5.3	6.3	5.7
Length of first acute hospital and rehabiltation admissions*		9.6	10.7	10.2	12.3	11.0	17.7	7.8	8.3
Length of first institutional episode*		11.8	17.0	11.4	15.7	14.1	23.4		
Number of days in acute hospital care, one year**		13.5	14.5	11.6	14.1	9.1	9.5	10.9	12.4
Number of days in acute hospital care and inpatient rehabilitation , one year**		15.5	19.0	16.8	24.3	23.7	54.9	14.7	18.9
Number of inpatient days, one year**		25.6	58.8	23.0	49.9	41.0	90.9		
Number of GP visits ,one year**		7.0	6.4	2.7	3.2	8.2	9.2	4.6	6.7
Number of other doctor visits, one year*		15.3	16.3	6.6	13.0	1.4	3.5	6.7	11.5
Number home help visits, one year**		38.1	154.9	19.8	86.3	56.6	176.8		
Cost of first acute hospital episode*		9719	8858	9719	9319	6497	5695	6726	6312
Cost of first acute and rehabilitation hospital episode*		9860	9095	10166	9739	7474	7212	7073	6622
Cost of first institutional episode*		10248	9465	10403	9956	8111	7812		
One year cost**		26359	23661	18984	20690	19886	25562		

* Oslo: excluded patients with index after September in 2014 (n=7457)

**Oslo: excluded patients with index day in 2014 (n=6548)

*** Stockholm: exluded patients with indexday beforethe first of July 2011 (n=11513)

Appendix Table 3. Descriptive statistics ischemic stroke

		Copenhagen 2014 (n=397)		Helsinki area 2009-2014 (n=5350)		Oslo 2009-2013/2014 (n=3776-4289)		Stockhom 2009/2011-2014 (n=11632-20404)	
		mean	sd	mean	sd	mean	sd	mean	sd
AGE*	**mean**	70.2	14.5	70.2	13.0	75.5	14.0	75.8	12.8
	age under 50	0.088	0.284	0.069	0.254	0.054	0.226	0.039	0.193
	age 50-54	0.073	0.261	0.049	0.215	0.034	0.181	0.027	0.162
	age 55-59	0.058	0.234	0.069	0.253	0.045	0.208	0.043	0.204
	age 60-64$	0.113	0.317	0.105	0.306	0.075	0.263	0.074	0.262
	age 65-69	0.139	0.346	0.144	0.351	0.095	0.293	0.107	0.309
	age 70-74	0.108	0.311	0.156	0.362	0.106	0.308	0.118	0.322
	age 75-79	0.118	0.323	0.151	0.358	0.115	0.320	0.134	0.340
	age 80-.84	0.113	0.317	0.136	0.343	0.166	0.372	0.165	0.371
	age 85-89	0.091	0.288	0.090	0.286	0.173	0.378	0.168	0.374
	age over 89	0.098	0.298	0.032	0.177	0.138	0.345	0.126	0.332
Gender*	**Male**	0.49	0.50	0.530	0.499	0.486	0.500	0.491	0.500
Cohort year *	**2009**			0.164		0.178		0.167	
	2010			0.162		0.174		0.173	
	2011			0.179		0.169		0.171	
	2012			0.178		0.182		0.167	
	2013			0.161		0.179		0.166	
	2014	1.000		0.157		0.120		0.156	
Number of days in different care arrangements within 90 days before index admission*	**Acute hospital days**	3.5	7.5	0.8	3.8	0.4	2.9	2.6	5.2
	Other inpatient days	6.8	22.9	1.7	10.0	11.1	28.3		
	Days at home with home help	21.5	36.4	1.5	8.7	15.2	32.3		
	Days at home without home help	58.1	40.6	86.0	14.4	63.3	40.3		
Share of patients in institution 90 days before stroke		0.071	0.256	0.011	0.104	0.107	0.309		
Comorbidities based on pervious year use of hospital care and prescribed medicines	**Hypertension**	0.63	0.48	0.68	0.47			0.72	0.45
	Coronary artery disease	0.03	0.18	0.06	0.24			0.08	0.27
	Atrial fibrillation	0.07	0.25	0.09	0.29			0.13	0.33
	Cardiac insufficiency (heart failure)	0.02	0.13	0.03	0.17			0.08	0.27
	Diabetes mellitus	0.17	0.38	0.19	0.39			0.17	0.38
	Cancer	0.02	0.15	0.08	0.27			0.04	0.20
	COPD and asthma	0.15	0.35	0.14	0.35			0.14	0.35
	Dementia	0.02	0.13	0.02	0.14			0.05	0.21
	Depression	0.15	0.36	0.13	0.34			0.18	0.38
	Parkinson's disease	0.01	0.10	0.02	0.13			0.02	0.14
	Mental disorders	0.06	0.23	0.03	0.18			0.03	0.17
Performance indicators									
30 -day mortality*		0.063	0.243	0.054	0.226	0.095	0.293	0.099	0.298
90-day mortality*		0.113	0.317	0.077	0.267	0.136	0.343	0.146	0.353
One-year mortality**		0.174	0.379	0.122	0.327	0.223	0.416	0.223	0.416
Share of patients discharged home (total)within 90 days*		0.705	0.456	0.768	0.422	0.689	0.463		
Share of patients discharged home (without help) within 90 days*		0.539	0.499	0.652	0.476	0.520	0.500		
Share of patients institutionalized (90 days)*		0.144	0.351	0.125	0.331	0.150	0.357		
Share of patients institutionalized (one year)**		0.06	0.24	0.04	0.20	0.094	0.292		
Length of first acute hospital episode*		13.2	15.9	9.6	6.9	13.5	12.5	7.7	7.5
Length of first acute hospital and rehabiltation episode*		16.9	22.4			24.0	26.5	15.2	15.3
Length of first institutional episode*		24.5	31.8	25.3	29.5	28.3	30.6		
Number of days in acute hospital care, one year**		15.8	18.4	11.9	10.5	15.4	14.2	11.6	11.9
Number of days in acute hospital care and inpatient rehabilitation , one year**		22.7	29.1	31.4	40.3	44.6	72.4		
Number of inpatient days, one year**		65.0	109.4	33.2	46.8	76.4	117.3		
Number of GP visits ,one year**		7.6	6.5	2.6	3.8	6.2	14.0	5.8	8.5
Number of other doctor visits, one year*		8.8	10.1	6.9	11.4	2.4	70.6	5.7	10.4
Number home help visits, one year**		118.4	452.4	32.3	112.6	93.4	114.3		
Cost of first acute hospital episode*		11637	14057	8517	6105	11946	11022	6844	6596
Cost of first acute and rehabilitation hospital episode*		12476	14946	10887	8516	14309	12671	8529	7533
Cost of first hospital episode*		14031	15927	11948	9432	15186	12853		
One year cost**		34941	38299	24229	24048	33209	33158		

* Oslo: excluded patients with index day after mid September 2014 (n=4389)

**Oslo: excluded patients with index day in 2014 (n=3776)

*** Stockholm: exluded patients with indexday before the first of July 2011 (n=11632)

Appendix Table 4. Descriptive statistics hip fracture (all patients)

		Copenhagen 2014 (n=471)		Helsinki area 2009-2014 (n=4523)		Oslo 2009-2013/2014 (n=4093-4600)		Stockhom 2009/2011-2014 (n=8803-15328)	
		mean	sd	mean	sd	mean	sd	mean	sd
AGE*	**mean**	78.5	11.7	79.9	10.6	82.3	10.2	82.0	9.9
	age 0-54	0.05	0.22	0.019	0.138	0.015	0.120	0.011	0.104
	age 55-59	0.04	0.19	0.035	0.183	0.023	0.150	0.020	0.138
	age 60-64$	0.06	0.24	0.053	0.224	0.037	0.190	0.038	0.191
	age 65-69	0.08	0.27	0.076	0.265	0.060	0.238	0.059	0.236
	age 70-74	0.08	0.28	0.085	0.279	0.065	0.246	0.083	0.276
	age 75- 79	0.16	0.37	0.134	0.340	0.108	0.311	0.116	0.320
	age 80-.84	0.18	0.38	0.201	0.401	0.180	0.385	0.192	0.394
	age 85-89	0.19	0.39	0.223	0.416	0.258	0.437	0.253	0.434
	age over 89	0.16	0.37	0.175	0.380	0.253	0.435	0.229	0.420
Gender*	**Male**	0.29	0.45	0.294	0.456	0.277	0.448	0.303	0.460
Type of Hip fracture*	**s720**	0.53	0.50	0.604	0.489	0.586	0.493	0.522	0.500
	s721	0.40	0.49	0.358	0.479	0.357	0.479	0.391	0.488
	s722	0.07	0.26	0.051	0.220	0.055	0.228	0.092	0.290
Cohort year *	**2009**			0.156		0.191	0.393	0.171	
	2010			0.168		0.183	0.387	0.169	
	2011			0.170		0.169	0.375	0.168	
	2012			0.174		0.180	0.384	0.169	
	2013			0.173		0.166	0.372	0.163	
	2014	1.000		0.160		0.110	0.313	0.160	
Number of days in different care arrangements within 90 days before index admission*	**Acute hospital days**	3.662	7.505	0.7	3.8	0.4	2.7	2.0	3.9
	Other inpatient days	18.705	32.949	20.4	34.8	28.4	40.1		
	Days at home with home help	28.310	37.751	11.9	25.8	19.8	35.2		
	Days at home without home help	39.323	41.141	57.0	39.6	41.3	43.8		
Share of patients in institution 90 days before AMI*		0.159	0.366	0.17	0.38	0.28	0.45		
Comorbidities based on pervious year use of hospital care and prescribed medicines***	**Hypertension**	0.658	0.475	0.665	0.472			0.682	0.466
	Coronary artery disease	0.034	0.181	0.041	0.198			0.061	0.239
	Atrial fibrillation	0.045	0.207	0.057	0.233			0.099	0.298
	Cardiac insufficiency (heart failure)	0.025	0.158	0.037	0.188			0.078	0.268
	Diabetes mellitus	0.102	0.303	0.153	0.360			0.113	0.317
	Cancer	0.017	0.129	0.042	0.200			0.053	0.224
	COPD and asthma	0.208	0.406	0.147	0.355			0.154	0.361
	Dementia	0.106	0.308	0.198	0.398			0.145	0.352
	Depression	0.246	0.431	0.287	0.452			0.298	0.458
	Parkinson's disease	0.040	0.197	0.050	0.217			0.040	0.195
	Mental disorders	0.072	0.259	0.092	0.289			0.053	0.223
	Stroke	0.030	0.170	0.031	0.174			0.066	0.249
Performance indicators									
30 -day mortality*		0.083	0.276	0.073	0.260	0.078	0.268	0.073	0.260
90-day mortality*		0.153	0.360	0.131	0.337	0.143	0.351	0.137	0.344
One-year mortality**		0.251	0.434	0.229	0.420	0.263	0.440	0.252	0.434
Share of patients discharged home (total)within 90 days*		0.575	0.495	0.570	0.495	0.477	0.500		
Share of patients discharged home (without help) within 90 days*		0.278	0.449	0.356	0.479	0.277	0.448		
Share of patients institutionalized (90 days)*		0.227	0.419	0.263	0.440	0.343	0.475		
Share of patients institutionalized (one year)**		0.121	0.326	0.163	0.369	0.230	0.421		
Length of first acute hospital episode*		15.2	9.1	9.24	7.55	10.35	7.84	7.37	5.37
Length of first acute hospital and rehabiltation episode*		27.6	24.4	30.6	24.5	31.3	29.3	16.9	11.2
Length of first institutional episode*		41.9	32.4	44.6	32.2	49.4	34.2		
Number of days in acute hospital care, one year**		19.4	16.0	11.4	11.7	11.7	9.5	11.3	11.2
Number of days in acute hospital care and inpatient rehabilitation , one year**		35.9	33.9	46.6	44.1	54.2	77.4	24.4	20.9
Number of inpatient days, one year**		100.8	123.8	120.9	133.4	139.6	144.7		
Number of GP visits ,one year**		8.2	7.3	1.9	4.0	2.9	6.5	2.9	5.6
Number of other doctor visits, one year*		7.1	8.1	5.3	10.6	0.7	1.9	4.5	8.9
Number home help visits, one year**		118.2	317.8	75.1	182.0	111.1	233.1		
Cost of first acute hospital episode*		12852	4731	10029	3874	10451	4076	8805	2872
Cost of first acute and rehabilitation hospital episode*		15641	7340	14862	6491	15180	7854	10955	3745
Cost of first hospital episode*		18505	8140	17696	7570	18850	7894		
One year cost**		45069	34166	43126	31829	46240	34246		

* Oslo: excluded patients with index day after mid September 2014 (n=4600)

**Oslo: excluded patients with index day in 2014 (n=6548)

*** Stockholm: exluded patients with indexday before the first of July 2011 (n=8803)

Appendix Table 5. Descriptive statistics hip fracture, non-institutionalised patients

		Copenhagen 2014 (n=396)		Helsinki area 2009-2014 (n=3741)		Oslo 2009-2013/2014 (n=2929-3306)	
		mean	sd	mean	sd	mean	sd
AGE*	**mean**	77.23	11.82	79.1	10.6	80.7	10.6
	age 0-54	0.06	0.23	0.021	0.142	0.020	0.139
	age 55-59	0.04	0.20	0.039	0.194	0.030	0.170
	age 60-64$	0.07	0.26	0.058	0.234	0.048	0.213
	age 65-69	0.09	0.28	0.085	0.279	0.076	0.264
	age 70-74	0.09	0.28	0.090	0.286	0.077	0.267
	age 75- 79	0.17	0.37	0.142	0.349	0.120	0.325
	age 80-.84	0.19	0.39	0.201	0.401	0.184	0.387
	age 85-89	0.16	0.37	0.207	0.406	0.243	0.429
	age over 89	0.14	0.35	0.157	0.364	0.203	0.402
Gender*	**Male**	0.31	0.46	0.303	0.460	0.293	0.455
Type of Hip fracture*	**s720**	0.52	0.52	0.608	0.488	0.597	
	s721	0.40	0.40	0.353	0.478	0.346	
	s722	0.08	0.08	0.052	0.223	0.055	
Cohort year *	**2009**			0.160		0.196	
	2010			0.166		0.180	
	2011			0.169		0.164	
	2012			0.174		0.179	
	2013			0.171		0.168	
	2014	1.000		0.160		0.114	
Number of days in different care arrangements within 90 days before index admission**	**Acute hospital days**	3.72	7.33	0.73	3.52	0.53	3.06
	Other inpatient days	5.83	15.34	5.92	15.68	4.45	13.78
	Days at home with home help	33.67	38.92	14.44	27.68	27.59	38.84
	Days at home without home help	46.77	40.80	68.90	32.79	57.43	41.77
Share of patients in institution 90 days before Hip fracture		0.000	0.000	0.000		0.000	0.000
Comorbidities based on pervious year use of hospital care and prescribed medicines	**Hypertension**	0.66	0.47	0.68	0.47		
	Coronary artery disease	0.03	0.17	0.04	0.20		
	Atrial fibrillation	0.05	0.22	0.06	0.23		
	Cardiac insufficiency (heart failure)	0.03	0.16	0.04	0.19		
	Diabetes mellitus	0.07	0.26	0.16	0.37		
	Cancer	0.02	0.13	0.05	0.21		
	COPD and asthma	0.19	0.39	0.15	0.36		
	Dementia	0.06	0.24	0.15	0.36		
	Depression	0.21	0.41	0.26	0.44		
	Parkinson's disease	0.04	0.18	0.05	0.22		
	Mental disorders	0.07	0.25	0.08	0.26		
	Stroke	0.02	0.15	0.03	0.17		
Performance indicators							
30 -day mortality*		0.081	0.273	0.065	0.247	0.054	0.227
90-day mortality*		0.119	0.324	0.110	0.313	0.114	0.318
One-year mortality**		0.212	0.409	0.198	0.398	0.213	0.410
Share of patients discharged home (total)within 90 days*		0.672	0.470	0.679	0.467	0.656	0.475
Share of patients discharged home (without help) within 90 days*		0.318	0.466	0.422	0.494	0.383	0.486
Share of patients institutionalized (90 days)*		0.154	0.361	0.169	0.375	0.181	0.385
Share of patients institutionalized (one year)**		0.066	0.248	0.082	0.274	0.092	0.289
Length of first acute hospital episode*		15.6	8.7	9.3	7.7	11.5	8.0
Length of first acute hospital and rehabiltation episode*		30.1	25.4	31.4	24.4	34.3	27.2
Length of first institutional episode*		36.2	30.2	38.6	29.4	39.1	30.8
Number of days in acute hospital care, one year**		20.1	16.2	11.7	10.8	13.1	9.7
Number of days in acute hospital care and inpatient rehabilitation , one year**		39.7	35.2	49.2	45.2	51.0	52.9
Number of inpatient days, one year**		81.9	?	93.1	112.6	93.6	116.6
Number of GP visits ,one year**		7.9	7.1	2.1	4.2	4.1	7.3
Number of other doctor visits, one year*		7.7	8.4	5.7	11.2	1.0	2.2
Number home help visits, one year**		140.6	342.1	88.6	194.9	127.8	238.3
Cost of first acute hospital episode*		12993	4547	10073	3950	11049	4152
Cost of first acute and rehabilitation hospital episode*		16294	7449	15072	6508	16202	7290
Cost of first hospital episode*		17512	8057	16527	7224	17177	7755
One year cost**		42366	33026	37809	28544	38162	30040

* Oslo:Excluded patients with index day after mid September 2014 (n=3306)

**Oslo: Excluded patients with index day in 2014 (n=2929)